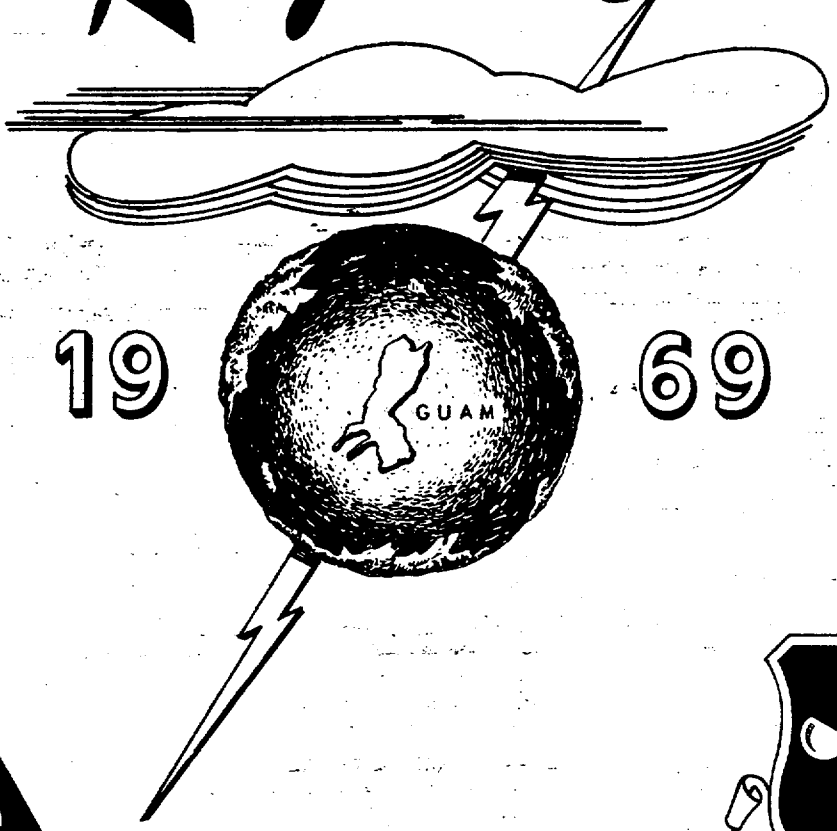
CAPT HOLLIDAY

ANNUAL TYPHOON Report



19 69

NAVAL WEATHER SERVICE

AIR WEATHER SERVICE

FLEET WEATHER CENTRAL/JOINT TYPHOON WARNING CENTER

Guam, Mariana Islands

SEE EDGE INDEX
ON BACK COVER

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (FROM - TO)
01-01-1995	Annual Typhoon Report	xx-xx-1995 to xx-xx-1995

4. TITLE AND SUBTITLE
1969 Annual Typhoon Report
Unclassified

5a. CONTRACT NUMBER
5b. GRANT NUMBER
5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
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Kinney, John J. ;

5d. PROJECT NUMBER
5e. TASK NUMBER
5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME AND ADDRESS
Joint Typhoon Warning Center
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Pearl Harbor, HI96860-3103

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME AND ADDRESS
Naval Pacific Meteorology and Oceanography Center
Joing Typhoon Warning Center
425 Luapele Road
Pearl Harbor, HI96860-3103

10. SPONSOR/MONITOR'S ACRONYM(S)
11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APUBLIC RELEASE
,

13. SUPPLEMENTARY NOTES
See Also ADM001257, 2000 Annual Tropical Cyclone Report Joing Typhoon Warning Center (CD includes 1959-1999 ATCRs). Block 1 and Block 3 should be 1969.

14. ABSTRACT
This report is published annually and summarizes Western North Pacific Tropical Cyclones. Annex A is added to summarize Tropical Cyclones from 180 degrees eastward to the North American Coast.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE	Public Release	170	Fenster, Lynn lfenster@dtic.mil
Unclassified	Unclassified	Unclassified			19b. TELEPHONE NUMBER International Area Code Area Code Telephone Number 703767-9007 DSN 427-9007

U. S. FLEET WEATHER CENTRAL
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FWC/JTWC:HLH:lmr
5213/4
Ser: 21
16 JAN 1970

From: Commanding Officer, U. S. Fleet Weather Central/Joint Typhoon Warning Center, Guam
To: Chief of Naval Operations
Via: Commander, Naval Weather Service Command

Subj: Annual Typhoon Report, 1969; submission of

Ref: (a) OPNAV Instruction 3140.17E of 29 Oct 65
(b) SECNAV Instruction 5600.16 of 2 Nov 60

1. The Annual Typhoon Report, 1969, is submitted herewith in accordance with reference (a).

2. During calendar year 1969, 13 typhoons, 6 tropical storms and 4 depressions were detected in the Western North Pacific from the International Date Line to the Malay Peninsula. A total of 430 warnings were issued during the 108 calendar days of "warning status" for the Joint Typhoon Warning Center, Guam.

3. Reference (a) directs Fleet Weather Central Pearl Harbor and Fleet Weather Central Alameda to foreward annual summaries of tropical cyclones in their respective areas to this command for inclusion in Annual Typhoon Reports. Fleet Weather Central Pearl issued no tropical cyclone warnings during 1969. Fleet Weather Central Alameda was in warning status 67 days during 1969 and issued a total of 219 warnings on 4 hurricanes, 6 tropical storms and 5 tropical depressions.

4. This report has been reviewed in accordance with reference (b).

J. H. NEGELE

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1969
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FOREWARD

This report is published annually and summarizes Western North Pacific Tropical Cyclones. Annex A summarizes Tropical Cyclones from 180 degrees eastward to the North American Coast.

When directed by CINCPAC in May 1959, CINCPACFLT redesignated Fleet Weather Central Guam as Fleet Weather Central/Joint Typhoon Warning Center (FWC/JTWC), Guam with the following responsibilities:

1. To provide warnings to U. S. Government agencies for all tropical cyclones north of the equator and west of 180 degrees longitude to the coast of Asia and Malay Peninsula.

2. To determine tropical cyclone reconnaissance requirements and assign priorities.

3. To conduct investigative and post-analysis programs including preparation of the Annual Typhoon Report.

4. To conduct tropical cyclone forecasting and detection research as practicable.

Air Force Asian Weather Central at Fuchu, coordinating with U. S. Navy Fleet Weather Facility Yokosuka was designated as alternate JTWC in case of failure of FWC/JTWC Guam.

The JTWC is an integral section of FWC/JTWC Guam and is authorized to be manned by three Air Force and three Navy officers and five enlisted men from each service. The senior Air Force Officer is designated as Director, JTWC.

The Western Pacific Tropical Cyclone Warning System consists of the Joint Typhoon Warning Center (JTWC), the U. S. Air Force 54th Weather Reconnaissance Squadron stationed at Andersen Air Force Base, Guam and U. S. Navy Airborne Early Warning Squadron One (VW-1) stationed at Naval Air Station, Agana, Guam.

The Joint Hurricane Warning Center in Hawaii, a coordinated agency composed of the U. S. Weather Bureau, Honolulu, the Air Force Central Pacific Forecast Center, and Fleet Weather Central Pearl Harbor, is responsible for tropical cyclone surveillance and issuance of warnings in the Central North Pacific area between 180 degrees and 140 degrees west.

U. S. Navy Fleet Weather Central, Alameda, California, is responsible for issuance of warnings from 140 degrees west longitude to the North American Coast.

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CHAPTER I

OPERATIONAL PROCEDURES

A. GENERAL

Services provided by the Joint Typhoon Warning Center (JTWC) include forecasts of tropical cyclone formation, intensification, direction of motion, speed of movement, wind intensity and changes in the size and intensity of the cyclone. The primary product of JTWC providing these services is the tropical cyclone warning issued in 1969 at 05Z, 11Z, 17Z and 23Z whenever tropical cyclones existed in the JTWC area.

FWC Guam provides computer and analysis support for JTWC.

Communications services for JTWC are provided by the Fleet Weather Central Nimitz Hill Division of Naval Communications Station, Guam.

B. ANALYSES AND DATA SOURCES

1. FWC ANALYSES:

a. Surface polar projection isobaric; 0000Z, 0600Z, 1200Z and 1800Z.

b. Surface mercator projection isobaric; 0600Z and 1800Z.

c. Surface micro-analysis of South China Sea region; 0000Z, 0600Z, 1200Z and 1800Z.

d. Sea surface temperature charts; daily.

e. Checkerboards (Stidd Diagrams) of selected tropical stations.

f. Time cross sections of selected tropical stations.

2. JTWC ANALYSES:

a. Sectional surface isobaric charts; hourly and 3 hourly as required.

b. Reconnaissance data.

c. 700 mb mercator projection contours; 0000Z and 1200Z.

d. 500 mb mercator projection contours; 0000Z and 1200Z.

e. 300 mb mercator projection contours; 0000Z and 1200Z.

f. Stidd diagrams of selected stations in the van of an approaching storm.

3. SATELLITE DATA:

The quality and quantity of satellite data available in 1969 was greater than ever before. ESSA 6 (later replaced by ESSA 8) and NIMBUS 3 provided local morning direct readout pictures. Nimbus 3 provided infrared direct readout pictures at night. Local afternoon ATS satellite pictures were available as a rectified digitized mosaic chart after an eight hour delay for processing.

4. RADAR:

Installation of weather radar at FWC Guam was completed in time for the 1969 typhoon season, but did not see much action.

5. COMPUTER PRODUCTS, 0000Z AND 1200Z:

a. Hemispheric analyses and barotropic prognoses for 1000 mb, 700 mb, 500 mb, 300 mb, and 200 mb.

b. Decomposition fields of the 500 mb (SD, SR and SL) analyses and prognoses. The SD, SR, and SL fields correspond to small scale disturbances, mean flow and long wave pattern respectively.

c. Computer analysis of tropical streamlines for the 700 mb, 500 mb, 400 mb, 300 mb, 250 mb, and 200 mb levels from FWC Pearl fields were used in 1969.

d. The HATRACK typhoon steering program based on SR prognostic fields was used on an operational time basis as a forecast aid.

e. The TYRACK typhoon steering program was operationally used during the 1969 season. This program utilizes the FWC Pearl tropical streamline fields for determining forecast movement.

f. Divergence charts based on FWC Pearl streamline fields were produced for evaluation beginning about 20 July. A preliminary report is included in Chapter III.

C. FORECAST AIDS

1. CLIMATOLOGY:

The following climatological publications were utilized:

a. Tropical Cyclones in the Western Pacific and China Sea Area (Royal Observatory, Hong Kong), covering 70 years of typhoon tracks.

b. Climatological Aid to Forecasting Typhoon Movement (1st Weather Wing).

c. Climatological 24-Hour Typhoon Movement (McCabe, J. T., 1961).

d. Western Pacific Typhoon Tracks, 1950-1959 (FWC/JTWC).

e. Far East Climate Atlas (First Weather Wing February 1963).

f. Annual Typhoon Report, 1968 (FWC/JTWC), covering tracks for 1959 - 1968.

2. PERSISTENCE:

Extrapolation of storm movement using average speed and mean direction was the most reliable method for 12 to 24 hour forecasts.

3. COMPUTER PRODUCTS:

a. The HATRACK typhoon steering program was run on the FWC Guam computer on an operational basis during 1969. Steering forecasts were made using the decomposition mean flow fields (SR) of the 700 mb, and 500 mb levels for prognostic fields through 72 hours. Empirical modification based on apparent error in earlier forecasts was used to obtain improved forecast positions.

b. TYRACK computer forecast steering from the 700 mb, 500 mb, 400 mb, 300 mb, mean 700/500 mb and mean 700/500/400/300 mb levels were used during 1969.

4. OBJECTIVE TECHNIQUES

During 1969 the following individual objective forecasting methods were employed:

a. ARAKAWA - surface pressure grid model.

b. HATRACK - based on 700 mb SR prognosis.

c. HATRACK - modified from 700 mb SR prognosis for 12 hour error. (for 24 hour forecasts)

d. HATRACK - modified from 700 mb SR prognosis for 24 hour error. (for 48 hour forecasts)

e. HATRACK - based on 500 mb SR prognosis.

f. TYRACK - based on program-selected best steering level from Pearl tropical fields.

Evaluation of these techniques is contained in Chapter III.

D. FORECASTING PROCEDURES:

An initial track based on climatology and extrapolation is developed for a 3 to 4 day period. The track is modified by considering the existing and forecast upper air patterns, numerical steering forecasts and the ARAKAWA objective method.

Subsequent forecasts become "educated" by longer period averaging of extrapolation error in speed and direction and through modification of computer forecasts to compensate for errors observed in earlier computer forecasts. A combination of extrapolation and climatology is the starting point for each forecast, with mesoscale analysis of the 700, 500 and 300 mb charts and the ARAKAWA objective forecast model used to modify or reinforce the extrapolation forecast. Position of tropical cyclones with respect to the 700 mb high center and ridge to the north and the 700 mb trough or break in the ridge to the west are the primary keys to 24 hour forecasting of recurvature or speed changes. The 200 mb level has been used to anticipate changes in intensity through assumptions of divergence in the southeast quadrant and convergence in the southwest quadrant of anticyclones. Tropical cyclones approaching a 200 mb anticyclone from the southeast are forecasted to intensify and those emerging from the west side of a 200 mb anticyclone are normally forecasted to weaken.

Extended range forecasting is based on extrapolation of the 24 hour track with reversion toward climatology and modified by SR and SL 500 mb forecast contours.

The resulting official forecast is an integration of both objective and subjective techniques with persistence in speed and direction the weighted favorite for short term forecasts.

E. WARNINGS:

Tropical cyclone warnings are numbered consecutively without regard for upgrading or downgrading of the storm between intensity stages. If warnings are discontinued and the storm again intensifies, warnings are numbered consecutively from the last warning issued. Amended or corrected warnings are given the same number as the warnings they modify. Forecast positions are issued as follows:

Tropical depressions	24 hr
Tropical storms	12, 24, and 48 hr (72 hr at 05Z and 17Z only)
Typhoons	12, 24, and 48 hr (72 hr at 05Z and 17Z only)

Forecast periods are stated with respect to warning time. Thus a 24 hour forecast verifies 26 hours after the aircraft fix data, 29 hours after the latest surface synoptic chart and 29 to 35 hours after the latest upper air charts.

Warning forecast positions are verified against the corresponding post analysis "best track" positions. A summary of results from 1969 is presented in Chapter III.

F. PROGNOSTIC REASONING MESSAGE:

Whenever warnings are being issued, an amplifying message is issued at 06Z and 18Z. This prognostic reasoning message is intended to provide meteorological units ashore and afloat with technical and non-technical reasoning appropriate to the behavior of current storms and the logic of the latest JTWC warnings.

G. TROPICAL WEATHER SUMMARY:

This message is issued daily from May through December and otherwise when significant tropical cyclogenesis is forecasted or observed. It is issued at 0600Z and combined with the prognostic reasoning message when warnings are being issued. It describes the location, intensity and likelihood of development of all tropical low pressure areas and significant cloud "blobs" detected by satellite.

CHAPTER II

RECONNAISSANCE

A. GENERAL

Land station and ship reports continue to be scarce in areas of tropical cyclone formation. The tropical cyclone warning system depends upon aircraft reconnaissance data to fix the location and strength of tropical cyclones. Only on rare occasions are land radar fixes or sequential reports available to compare with reconnaissance data. Increased satellite coverage during 1969 proved to be an invaluable aid in scheduling aircraft reconnaissance to achieve maximum effectiveness. Interpretation of storm intensity and center location from satellite pictures only is presently not sufficiently reliable for operational use. Continuous surveillance of tropical cyclones is of the utmost importance as illustrated by the explosive deepening of typhoon Kathy on November 6 from a system requiring great skill and persistence to locate in the afternoon to a nighttime reconnaissance indication of 60 knots only 12 hours later.

Four fixes per day were scheduled on all tropical cyclones following the initial fix which was normally coordinated with the earliest availability of reconnaissance aircraft on the scene. As a general rule VW-1 made fixes at 0900Z and 1500Z at low and intermediate levels and 54WRS made fixes at 2100Z and 0300Z at intermediate (700 mb) level. High level (500 mb) fixes were made on storms in the vicinity of higher terrain. Most storms were taken into warning on the basis of daylight investigative flight data.

B. RECONNAISSANCE RESPONSIBILITY

Squadrons responding to the reconnaissance requirements of JTWC through the TCRC in 1969 were U. S. Air Force 54th Weather Reconnaissance Squadron (54WRS) flying WC-130 aircraft from Andersen Air Force Base, Guam and the U. S. Navy Airborne Early Warning Squadron ONE (VW-1) flying WC 121N aircraft from the Naval Air Station, Agana, Guam.

C. EVALUATION OF DATA

Eye data from tropical cyclones is provided by low level penetration, intermediate level penetration or radar fixes from outside the center. Penetration data provides the best quality data including dropsonde soundings, minimum 700 mb height and sea level pressure, maximum observed wind (estimated), shape and character of the eye and feeder band information. The primary center of the cyclone is based on the location of minimum pressure at the surface, a parameter best obtained by low level penetration, however the nearly vertical structure of most tropical cyclones promises only slight loss of accuracy on intermediate penetration fixes. Radar fixes made outside the center introduce an attenuation and radar accuracy error not present in penetration fixes. Radar fixes are also based on the radar center rather than the pressure center of the storm. Not infrequently reports of centers determined independently by

wind, clouds, pressure and temperature will vary by 10 miles or more. The eye report contains a subjective estimate of fix accuracy which must also be taken into account in the determination of the storm location at warning time. A final factor in this determination is the forecasters ability to accurately forecast the direction and speed of movement of the storm. On a statistical basis this error rate is 4 to 5 miles per hour of forecast time. During 1969 the mean difference between the post analysis warning position and the published operational warning position was 20.7 N.M. Since the mean time difference from fix to warning time is two hours the forecast error contribution is 9 to 10 miles leaving a residual value of 11 N.M. attributed to the mean accuracy of reconnaissance fixes.

Short term variability in the actual cyclone track and the mean amount of "smoothing" incorporated in the best track analysis are subjective factors included within the 11 N.M. accuracy accorded reconnaissance fixes in operation use.

Maximum differences between warning positions and best track positions resulted when reconnaissance was not continuously maintained, when the developing storm has an indistinct and shifting center or when fix positions used for the warning position fell well outside the past season best track analysis.

D. COMMUNICATIONS

The primary means of communication between JTWC and reconnaissance aircraft was voice single sideband through Andersen Airways (AIE 2) serving as the primary air to ground station for both 54WRS and VW-1 weather missions. Secondary air to ground stations were Clark AFB, Fuchu Airways and Kadena Airways. When secondary ground stations were used eye data was passed to JTWC via the Joint Overseas Switch (JOSS). Eye data messages received by Andersen Airways were simultaneously received at JTWC by direct phone patch. A hard copy backup message was transmitted from Andersen over local teletype circuit SDE 9.

Average delay time from time of fix to receipt in JTWC by phone patch was 20 minutes including message preparation time in the aircraft and time to copy the message in JTWC. Maximum delay time by phone patch was 1 hour 21 minutes and minimum delay just a few minutes. Direct communications with reconnaissance aircraft permitted direction of aircraft on synoptic missions into areas of suspicion appearing on satellite.

E. SUMMARY OF RECONNAISSANCE SUPPORT

A reconnaissance fix accreditation system was devised in 1965 in an effort to establish an objective evaluation of reconnaissance effectiveness. The system has been in use with minor modifications since that time.

Fix times are scheduled as near as possible to warning time to still permit receipt of the data for consideration by JTWC

forecasters before release of the official warning. Prior to 1967 it was necessary to schedule fixes three hours before warning time. Improved communications in 1967 made it possible to schedule fixes only two hours before warning time.

AIRCRAFT RECONNAISSANCE DATA

(NUMBER OF FIXES AND INVESTIGATIONS)

1961	1962	1963	1964	1965	1966	1967	1968	1969
350	496	465	772	666	674	845	807	468*

*76 preliminary or intermediate (No Credit) fixes not included.

In addition there were 203 synoptic tracks flown in 1969.

TABLE 2-1

DELAY IN RECEIPT OF RECONNAISSANCE FIX DATA FOR 1969

METHOD	NUMBER OF CASES*	MAX DELAY TIME	MIN DELAY TIME	AVG DELAY TIME
PHONE PATCH	402	1 HR 21 MIN	0 HR 01 MIN	0 HR 20 MIN
SDE 9	49	2 HR 11 MIN	0 HR 10 MIN	0 HR 33 MIN
OTHER	33	1 HR 57 MIN	0 HR 10 MIN	0 HR 30 MIN

*Does not include 60 fixes made on cyclones that did not develop.

TABLE 2-2

COMPARISON OF DELAY TIMES WITH PREVIOUS YEARS

	1965	1966	1967	1968	1969
MAX DELAY TIME	60 HR 09 MIN	4 HR 33 MIN	11 HR 20 MIN	6 HR 25 MIN	2 HR 11 MIN
AVG DELAY TIME	1 HR 05 MIN	1 HR 02 MIN	0 HR 43 MIN	0 HR 25 MIN	0 HR 22 MIN
MIN DELAY TIME	0 HR 09 MIN	FEW MINUTES	FEW MINUTES	FEW MINUTES	0 HR 01 MIN
PERCENT OF EYE MESSAGES DELAYED MORE THAN 1 HR	39%	38%	16%	4%	2.8%
NUMBER OF FIXES RECEIVED AFTER WARNING TIME	34	30	23*	6*	3*
PERCENT OF FIXES RECEIVED AFTER WARNING TIME	5.7%	5.4%	3.1%	0.7%	0.6%

*Since 1967, fixes scheduled 2 hours prior to warning time vice 3 hours prior to warning time during previous years.

TABLE 2-3

DEFINITION OF FIX CREDITS AND EVALUATION OF TIMELINESS OF RECONNAISSANCE FOR 1969

CLASS	DEFINITION		1969
1	FULL CREDIT	From 1 hour before to 1/2 hour after levied time.	360
2	FULL CREDIT	Aircraft in assigned area within 1 hour before to 1/2 hour after levied time but unable to locate a center.	14
3	EARLY/LATE	Center located 1 to 1 1/2 hours before or 1/2 to 2 hours after levied time.	10
4	VERY EARLY/ VERY LATE	Greater than 1 1/2 hours before or more than 2 hours after levied time.	3
5	ATTEMPTED BUT MISSED FIX	Recon provided some useful peripheral data but no fix was made. Reasons may include clearance problems, mechanical trouble, low fuel, etc.	0
6	MISSED FIX	Missed fixes not falling into any category above.	6
7	FULL CREDIT	Fix made on investigative flight or synoptic track.	32
8	FULL CREDIT	Investigative flight, no fix made.	49
9	NO CREDIT	Preliminary or intermediate fix made between scheduled fixes.	76

TABLE 2-4

CHAPTER III

JOINT TYPHOON WARNING CENTER STUDIES

A. An Analysis of Tropical Cyclone Wind Velocity Forecasting Accuracy.

1. BACKGROUND:

A revised technique for forecasting maximum wind velocities was used in 1969. It is based on a smooth curve extrapolation of central pressures along the forecast track. The forecast central pressure and forecast latitude are used as arguments to enter the JTWC pressure/wind correlation to obtain a forecast velocity. Modification of this initial forecast velocity is made subjectively according to the storms position with relation to the subtropical ridge, divergence patterns along the track, cloud organization as depicted by satellites and the sea surface temperature gradients when appropriate.

2. DISCUSSION:

Errors in forecasting by this technique result from:

a. Normal instrument and/or reporting error in central pressures reported by reconnaissance aircraft.

b. Latitude error in the forecast track.

c. Failure of the intensity curve to follow the pattern established during early phases of the storm.

Aircraft dropsonde pressures are used on the confidence level of $\pm$ 5 mb. Both instrument error and minor differences in the placement of the dropsonde relative to the absolute minimum pressure in the eye on consecutive soundings are included in this confidence level. An analysis of the past several soundings is used to determine a consistent trace. Low level aircraft penetrations with direct readings of pressure improve the confidence level somewhat and provide anchor points for the tendency curve.

Errors in forecast latitude displace the entry on the pressure-wind correlation graph but generally contribute only 5 knots or less to the total error.

The primary source of error resulted from the breakdown of the extrapolation assumption when, as with typhoon Ida, a 55 millibar deepening was observed over an 18 hour period. Some typhoons go through more than one phase of intensification or do not follow a simple intensification-decay cycle.

3. DATA:

Table 3-1 records the 1969 season verification of maximum wind forecasts at warning time and all forecast times.

Figure 3-1 is the 24 hour maximum wind forecast

verification for individual typhoons of 1969.

Figure 3-2 is the frequency distribution of errors for 12, 24, and 48 hour forecasts of maximum winds.

Table 3-2 records the 1966 season verification for purposes of comparison.

4. ANALYSIS:

During the first 48 hours of each forecast period in 1969 absolute mean error increased at a mean rate of 2 knots every 6 hours from an initial error of 4.9 knots at warning time. The algebraic mean error was minus in all time categories indicating a forecast bias on the low side. The low bias increased from 1.9 knots at warning time to 6.8 knots at 48 hours.

The largest intensity errors were associated with the two most intense typhoons (Viola and Elsie), together with Typhoon Ida whose rate of intensification was unusually rapid and with Typhoon Susan, an off-season typhoon that ignored climatology in reaching 105-knot sustained velocity. Only these four typhoons significantly exceeded the mean absolute 24 hour forecast error of 13.7 knots.

The 24 hour intensity error distribution ranged from -45 to +35 knots with the median forecast 5 knots low and three-fourths of the forecast errors falling between -25 and +15. The 48 hour intensity error distribution ranged from -55 to +60 with the median forecast 5 knots low and three-fourths of the forecast errors falling between -35 and +10.

It is evident from the appearance of the forecast error distribution curves (Figure 3-2) that maximum wind forecast error increases with time and shows little skill at 48 hours. The median 12 hour forecast is accurate within $\pm$ 10 knots; the median 24 hour forecast is accurate within $\pm$ 37.5 knots.

In order to evaluate the relative success of the central pressure forecasting technique, the same analysis was made of the 1966 season accuracy of forecasting maximum winds. The results are reported in Table 3-2. Comparison shows a significant improvement in 1969. This is attributed to increased emphasis on forecasting maximum wind velocity and the effectiveness of the central pressure technique devised for this purpose.

5. CONCLUSIONS:

Forecasts of maximum wind for 12 and 24 hour time periods in 1969 have mean absolute accuracies of 9.0 and 13.7 knots respectively with a 5 knot bias toward underforecasting. These figures reflect a significant improvement over the 1966 season and indicate that the procedure described in this section is effective.

6. ACTION:

Continued use of the central pressure method of forecasting maximum winds is indicated for 1970 with an attempt to correct the tendency for slight underforecasting.

a. The algebraic mean values might suggest that forecasts could be improved in 1970 by merely increasing all forecasts by 5 knots, however, the frequency distribution in Figure 3-2 shows a modal value at zero error. Simply displacing the complex curve five knots to the right would not improve the distribution significantly. If the curve were pictured as symmetric with the errors on the positive side, the excess of forecasts in the range 10 to 25 knots too low becomes evident.

b. A study of these cases is indicated as the best way to improve performance in 1970. A further improvement may be realized from a climatological approach to mean rates of intensification. The climatic average values for the season used as minimum intensification forecasts should reduce the number of underforecast cases and produce a slight positive bias in mean values with a better centralized distribution.

TYPHOON INTENSITY VERIFICATION

	ABSOLUTE MEAN ERROR (KTS)					ALGEBRAIC MEAN ERROR (KTS)				
		FORECAST					FORECAST			
STORM	WARNING (CASES)	12-HR (CASES)	24-HR (CASES)	48-HR (CASES)	72-HR (CASES)	WARNING (CASES)	12-HR (CASES)	24-HR (CASES)	48-HR (CASES)	72-HR (CASES)
PHYLLIS	10.0 (21)	11.1 (19)	10.6 (16)	16.2 (12)	24.0 (4)	-1.0 (21)	+ 4.7 (19)	+ 7.1 (16)	+16.2 (12)	+24.0 (4)
SUSAN	8.9 (21)	15.9 (19)	20.8 (21)	39.5 (13)	33.3 (4)	-8.9 (21)	-14.1 (19)	-19.7 (21)	-34.5 (13)	-26.7 (4)
TESS	4.0 (10)	9.3 (7)	13.8 (8)	25.0 (1)	- (0)	+1.0 (10)	+ 6.4 (7)	+ 2.5 (8)	+25.0 (1)	- (6)
VIOLA	2.9 (24)	9.1 (23)	17.7 (22)	27.5 (16)	35.8 (6)	-0.8 (24)	+ 3.5 (23)	- 3.2 (22)	-21.9 (16)	-35.8 (6)
BETTY	2.0 (15)	7.1 (12)	12.7 (11)	9.2 (6)	15.0 (1)	-0.7 (15)	+ 0.4 (12)	0.0 (11)	+ 9.2 (6)	+15.0 (1)
CORA	1.0 (25)	3.2 (28)	7.4 (29)	13.2 (22)	15.6 (8)	+0.2 (25)	+ 2.1 (28)	+ 2.9 (29)	+ 1.8 (22)	- 5.6 (8)
DORIS	1.7 (9)	4.3 (7)	10.0 (5)	15.0 (1)	- (0)	-0.6 (9)	- 4.3 (7)	- 4.0 (5)	+15.0 (1)	- (0)
ELSIE	5.3 (31)	10.2 (28)	17.2 (30)	34.5 (22)	46.7 (9)	-0.8 (31)	- 0.5 (28)	- 2.8 (30)	0.0 (22)	- 3.3 (9)
GRACE	6.0 (29)	6.5 (23)	14.2 (25)	26.5 (17)	38.0 (5)	-4.3 (29)	- 2.6 (23)	- 9.4 (25)	-10.0 (17)	- 4.0 (5)
HELEN	6.7 (15)	11.4 (14)	13.6 (14)	31.9 (8)	12.5 (2)	-6.0 (15)	-11.4 (14)	-12.9 (14)	+ 0.6 (8)	-12.5 (2)
IDA	4.8 (24)	12.7 (22)	18.9 (22)	31.6 (16)	55.8 (6)	-4.0 (24)	- 7.3 (22)	-13.4 (22)	-30.3 (16)	-55.8 (6)
JUNE	5.6 (27)	8.5 (24)	9.3 (27)	10.3 (18)	17.1 (6)	0.0 (27)	- 3.1 (24)	- 5.6 (27)	- 9.2 (18)	-15.7 (7)
KATHY	3.2 (22)	8.3 (20)	10.0 (18)	12.1 (14)	11.0 (5)	+1.4 (22)	+ 5.3 (20)	+ 7.2 (18)	+ 3.6 (14)	- 7.0 (5)
ANNUAL TOTAL	4.9 (273)	9.0 (246)	13.7 (248)	22.9 (166)	30.2 (57)	-1.9 (273)	- 1.4 (246)	- 4.2 (248)	- 6.8 (166)	-13.3 (57)

TABLE 3-1

TYPHOON INTENSITY VERIFICATION

1966

	ABSOLUTE MEAN ERROR	ALGEBRAIC MEAN ERROR
	24-HR	24-HR
ANNUAL TOTAL	17.2 KTS	—3.4 KTS

TABLE 3-2

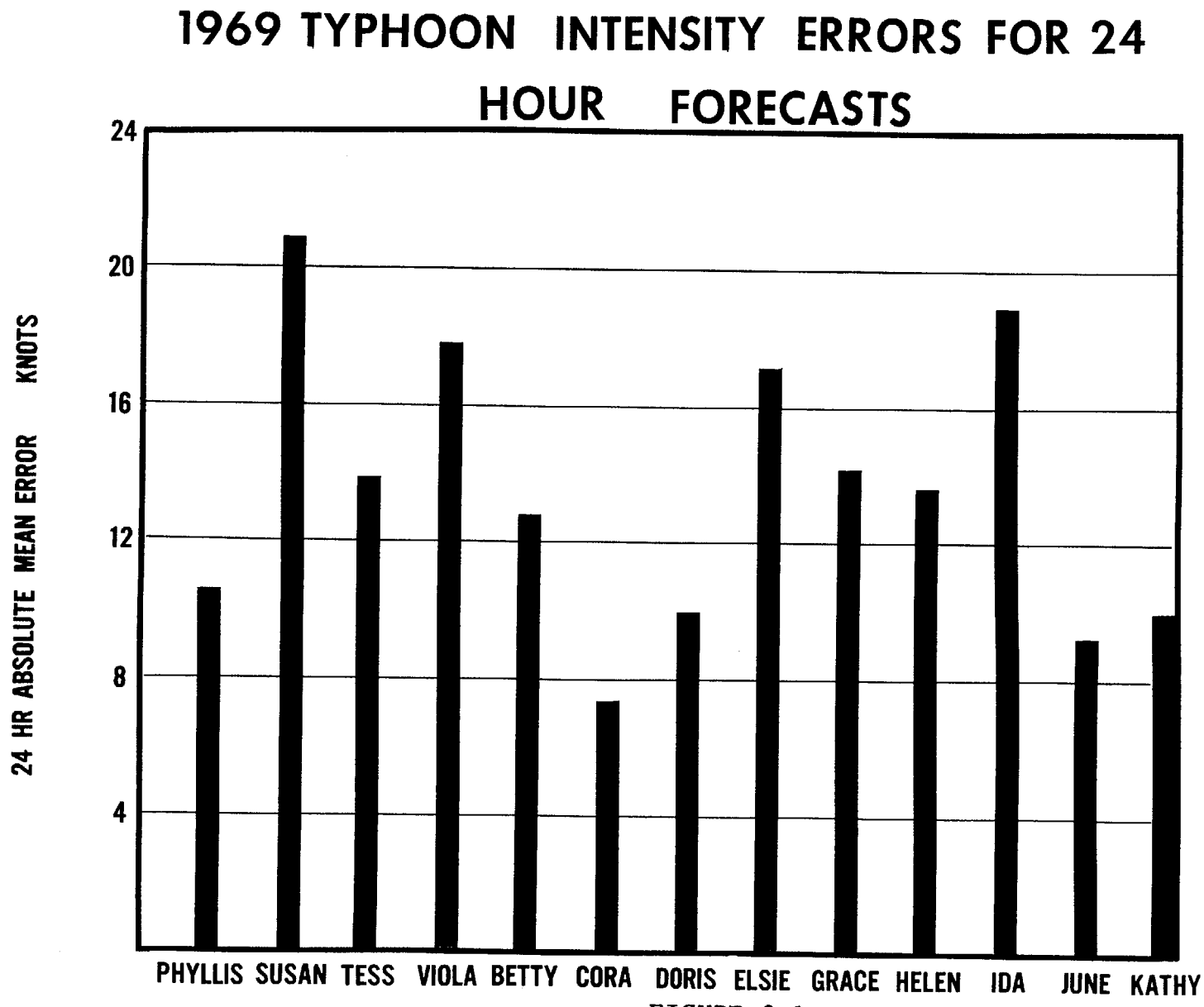

1969 TYPHOON INTENSITY ERRORS FOR 24 HOUR FORECASTS
24 HR ABSOLUTE MEAN ERROR KNOTS
24
20
16
12
8
4
PHYLLIS
SUSAN
TESS
VIOLA
BETTY
CORA
DORIS
ELSIE
GRACE
HELEN
IDA
JUNE
KATHY

FIGURE 3-1

INTENSITY FORECASTING SKILL 1969

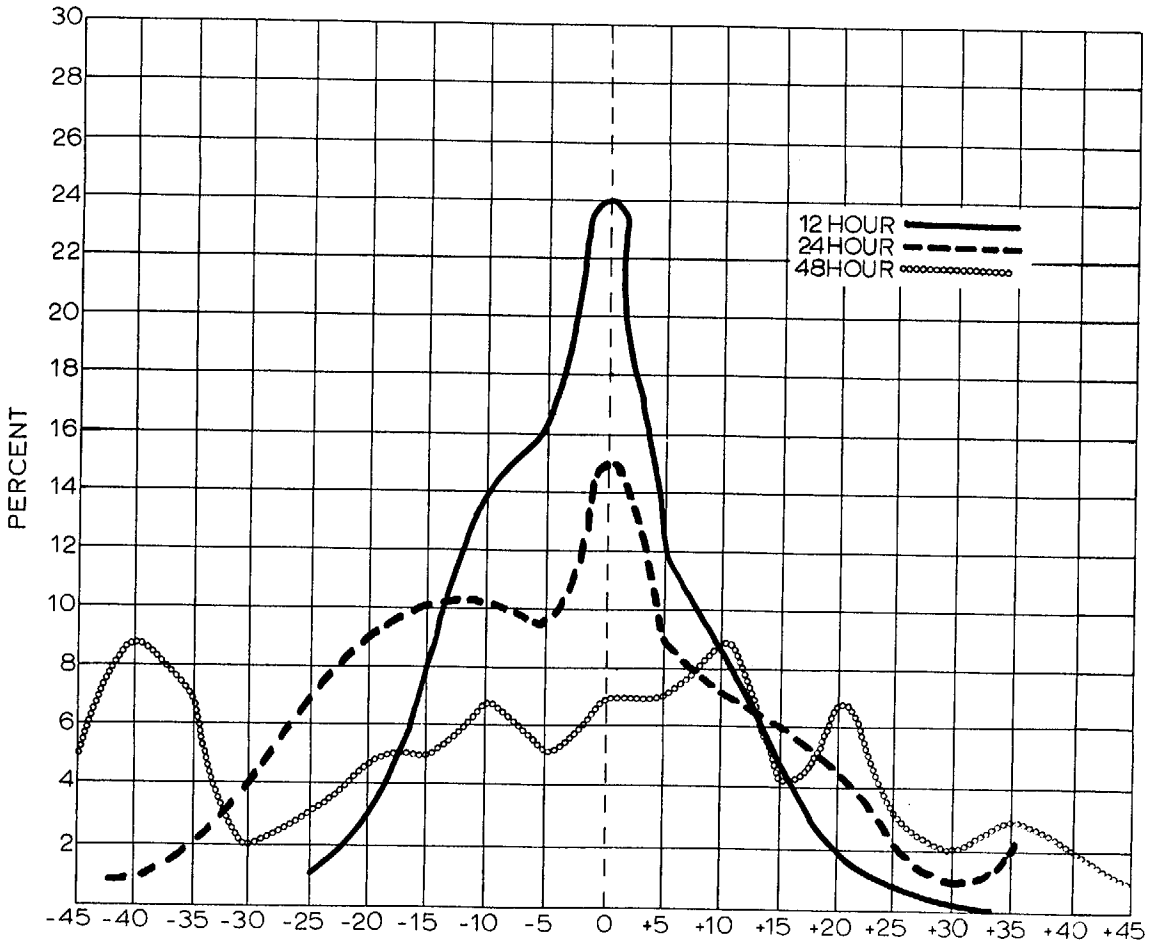


FIGURE 3-2

B. A Discussion of Tropical Cyclone Forecast Verification Methods and Seasonal Differences in Forecasting Difficulty.

1. GENERAL:

a. Mean Error: The verification method for tropical cyclone forecasts used since the establishment of JTWC has been mean absolute error, with the 24 hour error receiving the most attention. (See Figure 4-1)

b. Right Angle Error: Recognition of some basic inadequacies of the mean absolute error led to addition of the right angle error charts (See Figure 4-3) to depict track forecasting ability apart from speed errors.

c. Median Error: Occasional large forecast errors contribute disproportionately to the annual mean error as seen in Figure 3-3. All mean values are greater than their corresponding median values. In 1969 the median error for the over 200 MI cases was 265 MI. Six errors of 70 MI are needed to balance 200 MI errors. The extreme effect of this could be seen in 1960 when multiple storms, overtaxed reconnaissance resources and erratic tracks combined to produce more large forecast errors and resulted in a spread of 46 N.M. between median and mean values. Median error provides a more conservative and meaningful measure of forecast accuracy for the season. Since median error represents the 50 percent confidence level, any desired specific and significant point in the frequency distribution of errors (67%, 75%, 80% or 90%) could be selected as a more valid measure of skill than the mean absolute error. The few large forecast errors that do occur would contribute equally to the combined figure on a one forecast-one vote basis. It is interesting to note that both 1968 and 1969 median scores of 97 N.M. were records for the 11 year period of record.

d. Seasonal Differences: The increased difference in 1969 between the median score of 97 N.M. and the mean score of 111 N.M. illustrates the influence of a few large errors on the annual mean in a "light" typhoon year. The 1968 and 1969 seasons both had six recurving typhoons and a similar number of opportunities for large error during recurvature or on northeasterly accelerating storms even though the total number of warnings issued in 1969 was only about half of the 1968 total. Through midseason 1969 including Typhoon Doris the JTWC absolute mean error was 89 N.M. The influence of recurving Typhoons Grace, Helen, Ida, June, and Kathy was not balanced by any straight-running, late-season cyclones. The year ended with a respectable but disappointing 111 N.M. mean error. The potential for breaking 100 N.M. in mean error for a season remains good but depends on limiting the larger errors and the chance occurrence of well-behaved cyclones. This illustrates a basic difficulty in evaluating forecaster performance from year to year in the tropics. A sample of 100 tropical cyclones might constitute a representative sample of all situations

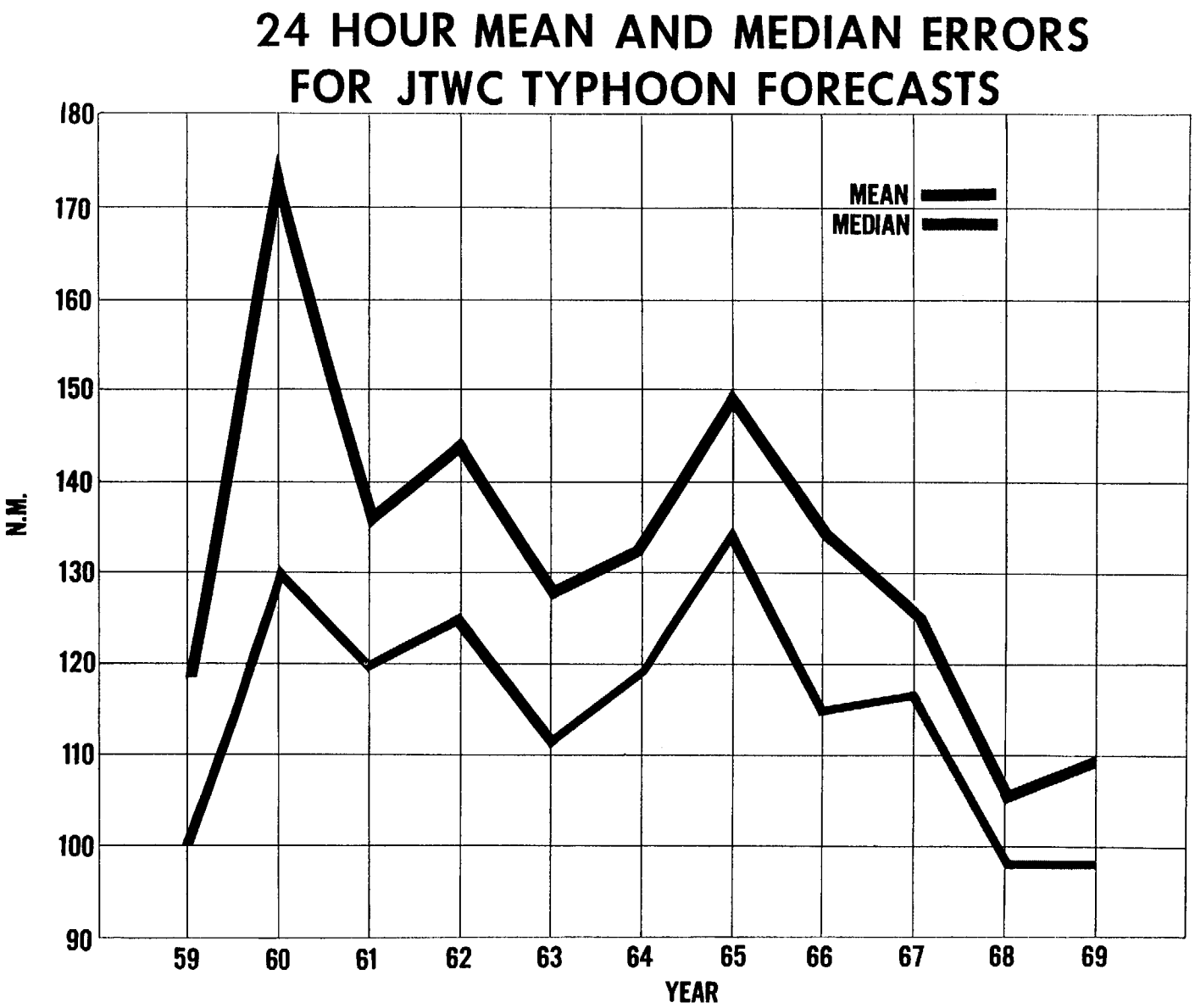

24 HOUR MEAN AND MEDIAN ERRORS
FOR JTWC TYPHOON FORECASTS
MEAN
MEDIAN
N.M.
180
170
160
150
140
130
120
110
100
90
59
60
61
62
63
64
65
66
67
68
69
YEAR

FIGURE 3-3

faced by the forecaster at one time or another, but a one-season sample of 20 or 30 cyclones is liable to contain a disproportionate number of recurving or erratic cyclones, resulting in a relatively high mean error. A sample containing straight-running cyclones, on the other hand, would produce a cushion of better than average forecasts. A method of evaluation including a measure of forecast difficulty would provide a more realistic appraisal of forecaster performance.

e. Displacement as Measure of Difficulty: A skill-scoring method sometimes mentioned for extratropical storms is based on error as a ratio of actual displacement during the forecast period. This method was used by LCDR Jerry Jarrell of Naval Weather Research Facility to examine JTWC annual forecast verifications from 1959 through 1967. (unpublished) The study has been updated for 1968 and 1969 and is presented graphically in Figure 3-4. The assumption made in this approach was that if a cyclone moves 500 N.M. in a 24 hour period, an error of 100 N.M. shows more skill than if the cyclone moved only 250 N.M. in the same period. In this system forecast errors are expressed as miles of error per mile of movement rather than the usual miles of error per 24 hour time period. In the first case the error rate would be 100/500 or .200. The error rate of the second example would be 100/250 or .400.

An implication of this system applied to individual forecasts is that slow-moving storms are easier to forecast than fast-moving storms. Such is not alwyas the case, as illustrated by recurving storms which execute the greatest change of direction and present the most difficult forecasting situation while moving at their slowest speed. The error-producing combination of deceleration, rapid change of direction and then acceleration challenge the ability of any forecaster. Even though the 24-hour distance moved in a recurve track is the same as that on a straight track, the recurving storm is a much more difficult one to forecast. A quasistationary storm could never score well in the system because of the small denominator in the skill ratio. An excellent verification error of 50 N.M. made while the storm only moved 75 miles would not appear to have much skill. Applied to yearly mean values the system may avoid objections raised on the basis of individual forecasts. In the application of this technique to JTWC forecasts the mean displacement value and mean error are used to produce mean error ratings for each year. The variability of individual years in mean displacement values is evidence of significant differences in mean storm behavior from year to year. Under this rating system the 1969 season with a mean 24-hour speed of 12.4 knots for all typhoons would be more difficult to forecast than the 1968 season when a mean 24-hour speed of 9.2 knots was recorded. Compared with the past 11 years the 1969 season ranked 1st in difficulty and 1st in accuracy by the mean error to displacement ratio.

f. Objective Technique Scores as a Measure of Difficulty: A second indication of basic differences between

MEAN ERROR TO DISPLACEMENT RATIO

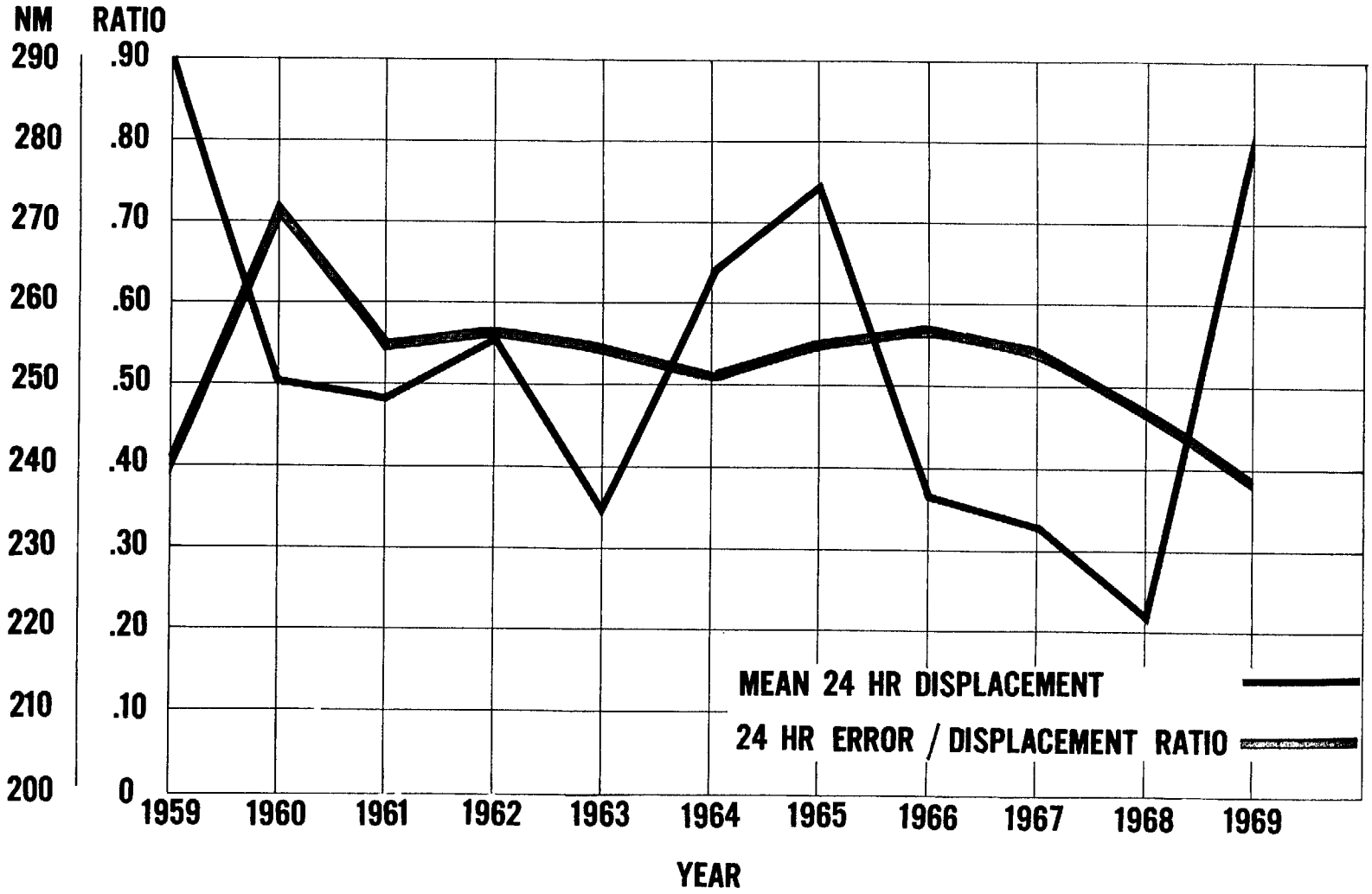


FIGURE 3-4

seasons is the variability noted in extrapolation and Arakawa objective technique scores in Table 3-3. The samples used in constructing the table included forecasts for tropical cyclones of all classes. (The JTWC values in this sample therefore may differ from official verification figures which include only those cyclones reaching typhoon strength.)

EXTRAPOLATIVE TECHNIQUE SCORES

YEAR	JTWC	EXTRAP	ARAKAWA
1967	121 NM	136 NM	NOT USED
1968	103 NM	108 NM	119 NM
1969	121 NM	131 NM	137 NM

TABLE 3-3

Extrapolation as used at JTWC includes a considerable amount of subjective judgement by the forecaster. The extrapolation forecast is usually the starting point for each official forecast. The fact that official forecasts have improved upon intelligent extrapolation by 5% in 1968, 9% in 1969 and 11% on a small sample in 1967 indicates a consistent mean skill on the part of the JTWC forecasters to do what they purport to do-forecast typhoon movements. A function of the difference between extrapolation error and mean error might serve as a measure of forecaster skill and JTWC performance. The Arakawa technique has consistently proved to be the best of truly objective techniques. This method eliminates the subjectiveness of extrapolation and may reflect the differences in difficulty between seasons better than any other simple method. The technique is firmly based in extrapolation. Errors recorded by this technique should be a good measure of the amount of nonsteady state change occuring. The 1969 mean Arakawa error of 137 N.M. compared to the corresponding 1968 value of 119 N.M. is interpreted to indicate that 1969 cyclones were more irregular in movement than those of the previous year, a fact well supported by personal observation.

2. CONCLUSIONS:

a. An objective means of rating the difficulty of a typhoon season should be considered in addition to the single value of mean or median accuracy. The Arakawa technique is favored for this purpose.

b. Median scores should be included in future annual reports as an alternate measure of forecast accuracy.

c. The error to displacement ratio is not considered an indicator of forecasting skill, but displacement serves to point out the differences in storm behavior between one season and another.

C. Frequency Distribution of Error in JTWC Official Forecasts.

1. BACKGROUND:

Operational use of JTWC tropical cyclone warnings requires an appreciation of the frequency and nature of forecasting error likely to be encountered. This article is an effort to describe the frequency distribution to form a realistic basis of understanding for both the operational user and the JTWC forecaster.

2. PROJECT SCOPE AND DESIGN:

Mean 24-hour absolute errors on all storms designated as typhoons from 1959 to the present were counted and totaled by 10-knot intervals. The total frequencies were graphed and a smooth-curve analysis made (See Figure 3-5). A total of 4236 forecasts were included in the study. In order to provide an operationally useful tool the individual interval totals were converted to cumulative percentages for two periods: 1959-1967 and 1968-1969. (See Figure 3-6.) It is difficult to estimate whether the improved performance of the last two or three seasons can be maintained in future typhoon seasons. Both curves have been presented to show the long-time and recent experience.

3. DISCUSSION:

The cumulative percentages on the Y-axis can be used as desired levels of confidence to find the error margin in N.M. associated with this confidence level on the X-axis.

CONFIDENCE TABLE

LEVEL	59-67 (NM)	68-69 (NM)	IMPROVEMENT
50%	118	97	17.8%
67%	162	126	22.2%
75%	186	147	21.0%
80%	206	164	20.4%
90%	260	220	15.4%

TABLE 3-4

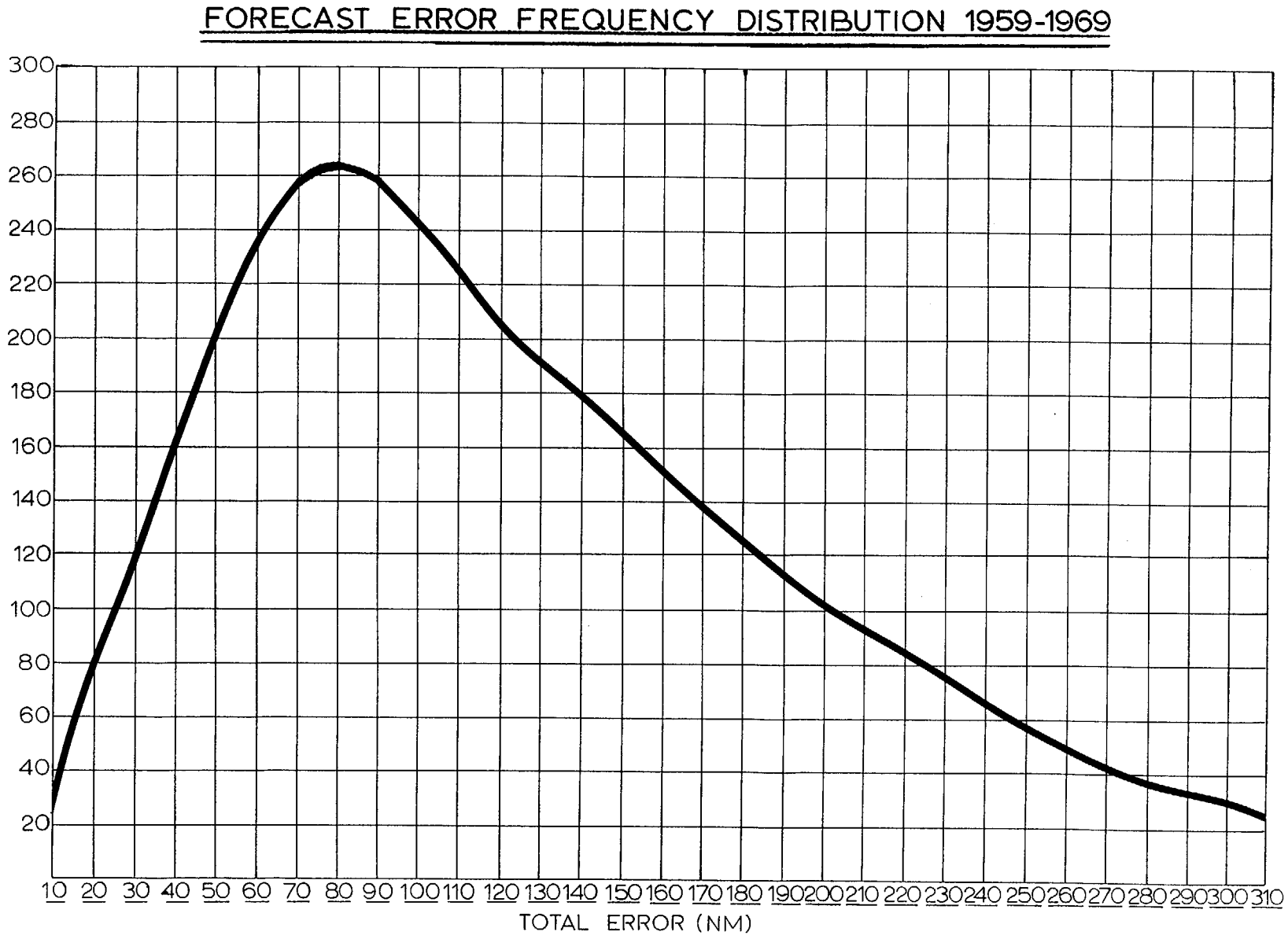

FORECAST ERROR FREQUENCY DISTRIBUTION 1959-1969
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310
TOTAL ERROR (NM)

FIGURE 3-5

CUMULATIVE PERCENT OF FORECAST ERROR BY MILES OF ERROR

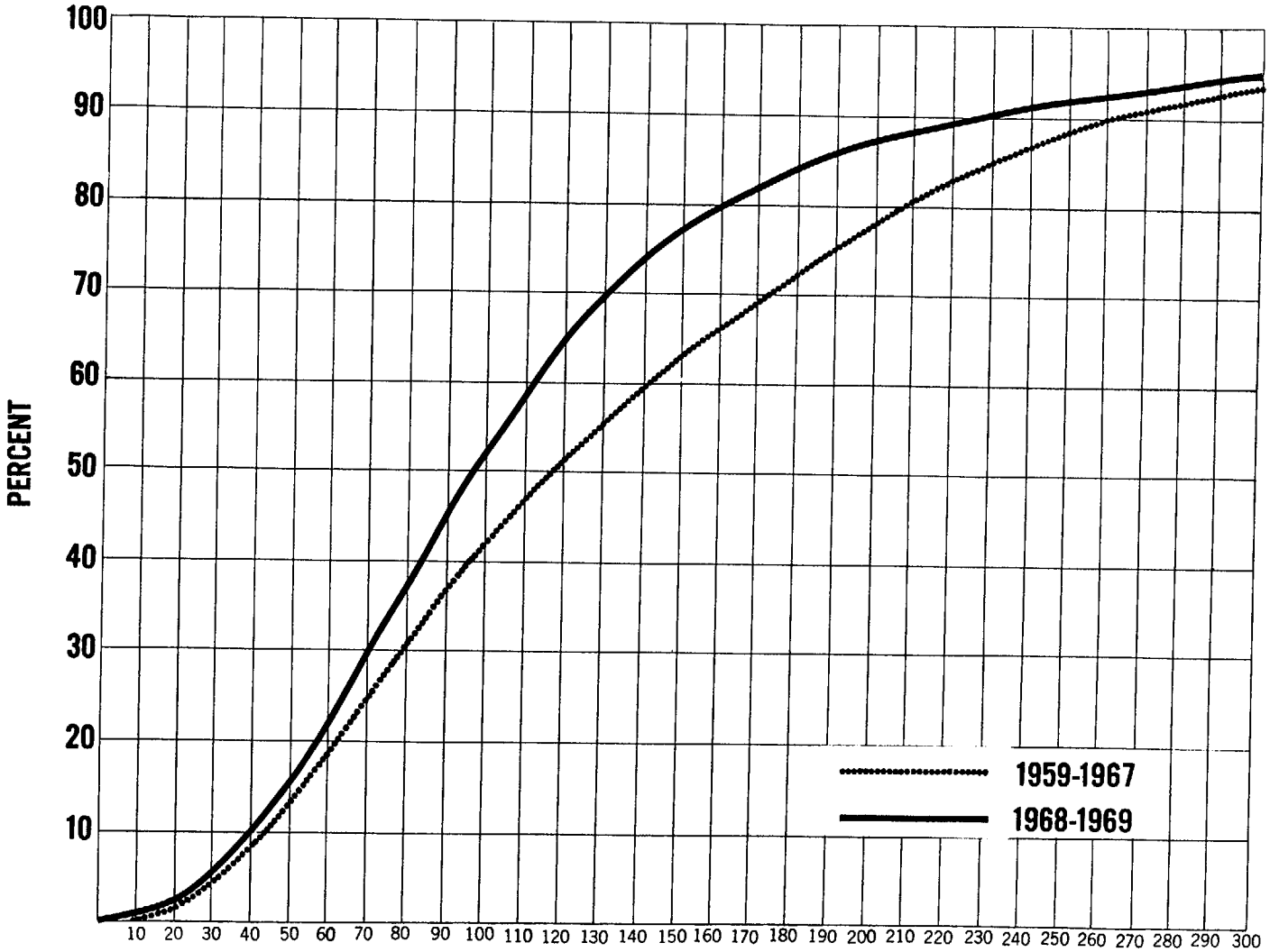


FIGURE 3-6

4. CONCLUSIONS:

a. It is noted that even though median and modal scores have reached record accuracies in 1968 and 1969, they don't measure the full extent of the forecast improvement realized. The maximum improvement is recorded near the one sigma level with over 22% improvement made in two-thirds of all forecasts.

b. The area of major improvement in the curve was between 40 N.M. and 160 N.M. and in this area represents a 30 to 40 N.M. increase in confidence level.

c. The failure to limit large errors is evident as the 90% and greater confidence levels are entered. Less improvement has been made in the upper 10 percent than in the average forecast range.

d. The incidence of errors exceeding 200 N.M. has been reduced from 21% to 12% but remains the necessary area of concern both because of the disproportionate influence on mean values and the potential for severe weather damage due to lack of adequate or timely warnings.

e. Very little improvement has been realized in the upper 5%. About 15 or 20 forecasts per year are so unpredictable that 24-hour errors will exceed 300 N.M.

f. In addition to this graphic approach to confidence level, the nature of each forecast situation should be considered. A storm moving in a northeasterly direction is, for instance, less accurately forecasted than other situations.

D. Causes and Cures for Forecast Errors Exceeding 200 N.M.

1. GENERAL:

A study of errors over 200 N.M. for the 1968 season was made to determine contributory factors and identify areas of possible improvement.

It was noted that the individual characteristics of each storm predispose large forecasting errors. Eleven of the 20 typhoons of 1968 had no forecasting errors greater than 200 N.M. The nature of each storm is, however, more a matter of hindsight rather than an evident feature of a storm prior to onset of looping, acceleration or generally erratic movement. Errors over 200 N.M. occur during all phases of the life cycle of tropical cyclones. In 1968 the early phases of a storm accounted for one-fourth, the late phases for one-fourth and the mature stage for the remaining one-half of large errors. The six identified factors contributing to large errors were:

a.	Forecaster Technique	1/6
b.	Misleading Recon Data	1/6
c.	Lack of Recon Data	1/6
d.	Looping Motion or Quasistationary Periods	1/6
e.	Acceleration on Northeasterly Track	1/6
f.	Unusual Motions to Southwest or Sharp Recurvature etc.	1/6

Fujiwhara motions would also result in large errors but have not been common in 1968 or 1969.

Improvement of individual forecasts in the six categories is the present subject of JTWC operational research. The study of forecaster confidence reported in this annual points up the basic inability of the forecaster to anticipate large errors in many situations. Even under those circumstances when he can recognize the potential for large error, he is able to limit his error to average values in only half of the cases.

A forecaster's handbook for JTWC is being prepared as an aid to improve forecaster technique in minimizing these errors, particularly those resulting from misleading reconnaissance data.

The lack of reconnaissance data during the first 12 to 18 hours of warning of many developing storms is common. When a daylight investigation locates a depression, continuous reconnaissance is generally planned for the following morning. If the cyclone is moderately well developed when first located

or forecasted to develop rapidly, fixes are requested as soon as possible. During the initial period of development prediction of the direction of movement of tropical cyclones is frequently not very successful. Only after two or three "fixes" are we able to state with good confidence where the cyclone is or is going. The selection of the initial track is made on the basis of climatology, synoptic steering, and various objective techniques. Because of aircraft scheduling problems and the need to place cyclones in warning as soon as their development can be predicted, only small improvement can be expected in this area in the future.

Looping motions are a two-edged sword to forecasting accuracy. The sometimes sudden deceleration finds two or three forecasts far overshooting the storm and a consequent acceleration out of the loop leaves two or three quasistationary forecasts far behind. A study of loop duration, exit speeds and directions and a means of anticipating the breakout will be undertaken to provide a degree of error reduction in this difficult situation.

A study of accelerations on northeasterly tracks reveals a persistent underforecasting of northeast movements during 1968 and 1969 as well as in many years past. The average 24 hour error for northeasterly moving storms in 1968 was 156 N.M. on 52 cases. The 1969 average of 127 N.M. for 45 cases was some improvement, but forecasts remained persistently behind actual acceleration. During 1969 ten of forty-five northeasterly forecasts were in advance of actual movement, none by more than 65 miles. In 1968 ten of fifty-two forecasts were in advance of actual movement, six of them on the same storm and three of these 160 to 180 N.M. in advance of actual movement.

The experience of 1968 and 1969 is being used to identify storms with an expected accelerating track to the northeast and to compensate for the persistent underforecasting of movement seen in past years in 1970 operational forecasting.

The final category of movements to the southwest, sharp recurvatures and other unusual actions will continue to produce a few large errors. The best hope for improvement in these storms that fail to follow extrapolation may be found in the analog technique now under development.

A follow-up study in 1969 found that three typhoons accounted for 72% of the 24-hour errors over 200 N.M. and all of the 24-hour errors exceeding 300 N.M. Elsie, Grace and June were the misbehaving ladies. Elsie settled down after a rather unpromising beginning but Grace and June remained erratic throughout their lifetimes.

E. A Comparison of Objective Techniques for Typhoon Movement.

1. STATUS:

Forecasts using seven different objective techniques were used and verified for all four warning times for all 24 hour forecasts issued by JTWC in 1969. Techniques showing the best results in 1968 were retained and those failing to show promise were discontinued.

2. 24 HR OBJECTIVE TECHNIQUES:

a. JTWC - official forecast for comparison.

b. EXTRAPOLATION - a semi-objective method by which forecast points are determined by recent past values of position, speed and direction.

c. ARAKAWA - grid overlay values of surface pressure are entered into regression equations and hand computed.

d. 700 mb PROG - HATRACK forecast based on 700 mb SR forecast fields.

e. 700 mb PROG MOD (12 Hr) - (d.) is modified by twice the recent 12 hr vector error.

f. 500 mb PROG - HATRACK forecast based on 500 mb SR forecast fields.

g. 700/500 mb PROG RENARD - method using HATRACK 700 mb longitude and HATRACK 500 mb latitude (reported in 1968 annual).

3. MODIFICATION TECHNIQUES:

a. A single correction vector equal to twice the most recent 12 hour error correction vector is applied to the 700 mb prog forecast to produce the 700 mb prog mod forecast.

b. A 12 hour history position is provided as an input to the TYRACK program. The apparent speed and direction over the past 12 hours is computed and used to select the best steering level and to correct the forecast steering of that level for observed differences from history.

4. TESTING AND RESULTS FOR 24 HOUR FORECASTS:

A homogeneous sample of 210, 24 hour forecasts, for tropical storms and typhoons was assembled for 1969. Results are summarized in Table 3-5. The following general observations are offered:

OBJECTIVE METHODS STATISTICS 1969
(24 HR MEAN VECTOR ERRORS N.M.)

STORM	(CASES)	JTWC	EXTRAP	ARAKAWA	700P	700P*	500P	RENARD	TYRACK
T. PHYLLIS	(13)	150	160	154	183	230	379	160	175
T.S. RITA	(3)	60	56	54	540	162	320	542	292
T. SUSAN	(5)	74	99	63	333	282	398	291	252
T. TESS	(3)	134	96	66	314	150	232	338	90
T. VIOLA	(14)	93	127	129	232	161	194	207	177
T.S. WINNIE	(3)	120	100	108	266	-	242	296	182
T.S. ALICE	(2)	195	222	243	123	-	171	171	276
T. BETTY	(9)	108	115	118	246	267	255	276	250
T. CORA	(25)	88	85	87	187	121	198	198	113
T. ELSIE	(23)	78	97	94	225	57	238	228	267
T. GRACE	(25)	186	254	337	292	222	398	278	505
T. HELEN	(14)	184	242	215	406	158	342	361	337
T. IDA	(20)	88	94	86	138	116	122	129	271
T. JUNE	(25)	140	138	123	170	100	244	141	205
T. KATHY	(17)	146	139	144	240	168	354	192	240
T.S. LORNA	(9)	129	156	108	268	201	314	218	150
ANNUAL MEAN VALUES	(210)	124	142	144	235	154	272	221	251

TABLE 3-5

* 700PROG MOD (12) has only 124 cases. Comparisons cannot be made on a homogeneous basis between this and other objective methods. Many of the missing forecasts involved extreme forecasts and were omitted as not meaningful.

a. JTWC official forecasts are again significantly better than any single objective technique.

b. Extrapolation continues to be the single most reliable objective technique. The 1969 extrapolation error of 142 N.M. increased 28 percent over the 1968 value of 111 N.M. The improvement over extrapolation of the JTWC official forecast increased from 5 percent in 1968 to 13 percent in 1969.

c. Arakawa forecasts remain very close to extrapolation and increased 16 percent over the 1968 value of 121 N.M.

d. The HATRACK 700 mb prog again verified better than the 500 mb prog but total error of 235 N.M. is excessive.

e. The 700 mb prog mod (12 Hr) - again improved on the performance of the unmodified forecast with performance approaching that achieved by the Arakawa surface pressure method.

f. The 700/500 mb prog Renard method again improved upon the performance of both the 700 mb and 500 mb HATRACK forecasts by 7 percent over 700 mb and 19 percent over 500 mb.

g. The TYRACK forecasts were disappointing in total accuracy but provided the most realistic and usable track forecasts during the season, particularly for recurving storms. Large speed errors continue and show need for additional program controls. The continued improvement in 48 and 72 hour right angle error is in part due to guidance from the TYRACK track forecast.

h. Individual forecasts in a non-homogeneous sample were examined from the viewpoint of determining the forecast method producing the individual absolute best verification score. The results are presented in Table 3-6.

BEST INDIVIDUAL OBJECTIVE FORECASTS

	JTWC	EXTRAP	ARAKAWA	700P	700PMOD	500P	RENARD	TYRACK
#TOP	76	49	66	11	29	15	14	34
CASES	282	279	265	235	134	227	224	256
RATE	.270	.176	.249	.043	.217	.066	.063	.133

TABLE 3-6

The JTWC forecast does not always produce the absolute best forecast but is more consistent. Cases where extrapolation or Arakawa produced a best forecast often involved a difference of only a few miles from the official forecast. Mean deviation from the JTWC forecast in these cases was

48 N.M. for extrapolation and 53 N.M. for Arakawa. This points out an area of potential improvement since 115 of 282 cases could have been improved by closer use of extrapolation or Arakawa objective techniques. Since all forecasts begin with extrapolation the remaining 167 forecasts must represent situations where extrapolation was correctly modified to produce a better official forecast. Further research aimed at developing procedural rules for limiting the deviation from Arakawa and extrapolation should improve some of the 18 cases in which the JTWC error was over 100 N.M. greater than extrapolation or Arakawa.

i. Tables 3-7 and 3-8 present stratified analyses of 1969 objective methods. Table 3-9 applies stratification by latitude to JTWC official forecasts. The 1969 sample is not large enough to guarantee representative figures in all stratifications but most results support previous observations. The following tentative conclusions based on stratification are offered:

(1) All computer methods except the 700 mb prog modified for 12 hour error performed best at higher latitudes with northeasterly moving storms. Arakawa did not work well at all for these storms. Extrapolation error was high due to acceleration. The 700P(MOD) provided a fair overall forecast for northeasterly moving storms.

(2) The most forecastable storms were those south of the ridge line. JTWC, Arakawa and extrapolation scored best on these. The 102 N.M. error for Arakawa on 77 westerly moving storms is very convincing.

(3) Stratification by wind extensity shows improved steering with increased intensity for all except the extrapolative techniques.

OBJECTIVE FORECAST STRATIFICATION
ERRORS BY DIRECTION OF MOVEMENT

	001-090°	091-259°	260-300°	301-360°
JTWC	152 (44)*	226 (15)	98 (74)	113 (77)
EXTRAP	179 (44)	246 (15)	110 (74)	130 (77)
ARAKAWA	231 (44)	218 (15)	102 (74)	121 (77)
700P	197 (44)	307 (15)	262 (74)	218 (77)
700P(MOD)	168 (30)	186 (10)	150 (39)	143 (45)
500P	205 (44)	457 (15)	290 (74)	258 (77)
RENARD	187 (44)	299 (15)	247 (74)	200 (77)
TYRACK	224 (44)	249 (15)	260 (72)	259 (77)

* Cases shown in parens

TABLE 3-7

OBJECTIVE FORECAST STRATIFICATION
ERRORS BY INTENSITY

MAX WINDS	$<$50 KT	$\geq$50 KT	ALL WINDS
JTWC	132 (60)	121 (150)	124
EXTRAP	130 (60)	146 (150)	142
ARAKAWA	128 (60)	151 (150)	144
700P	286 (60)	215 (150)	235
700P(MOD)	186 (26)	146 (98)	154
500P	295 (60)	263 (150)	272
RENARD	277 (60)	198 (150)	221
TYRACK	282 (59)	239 (149)	251

* Cases shown in parens

TABLE 3-8

OFFICIAL JTWC FORECAST
STRATIFIED BY LATITUDE

	24 HR	48 HR	72 HR
SOUTH OF 20N	103 (132)	202 (63)	305 (16)
20N to 30N	117 (96)	240 (82)	346 (31)
SOUTH OF 30N	109 (228)	224 (145)	332 (47)
NORTH OF 30N	134 (20)	330 (21)	429 (10)
ALL CASES	111 (248)	237 (166)	349 (57)

* Cases shown in parens

TABLE 3-9

F. Confidence Forecasting.

1. BACKGROUND:

Forecaster confidence in his product is an often discussed parameter. If a forecaster were able to anticipate his good and bad forecasts, operational users would benefit from this information. In response to discussions of the 1969 Typhoon Conference an operational research project was designed to record and evaluate the accuracy of forecaster confidence at the time of forecast at JTWC.

2. PROGRAM SCOPE AND DESIGN:

The confidence forecast sample was 205 separate confidence forecasts from April through October of 1969. The sample included tropical storms as well as typhoons. The Director, Operations Officer or Typhoon Duty Officer completed a series of objective and subjective forecasts of confidence after each official warning but prior to the next aerial reconnaissance fix. The objective methods used were:

a. Area Climatology of Errors Based on Mean 1968 Experience: The assumption of this approach is that the difficulty of forecasting can be predicted from the location of the cyclone at the time of forecast.

b. Area Climatology by Category: This approach used the same data base as the first but makes only the category forecasts of average (110 N.M.) below average (70 N.M.) or above average (150 N.M.)

c. Mean Climatology: A representative mean climatology of 110 N.M. was applied to all forecasts.

d. Persistence: The 24 hour error determined at forecast time was forecasted to persist for the next 24 hours.

e. Subjective Forecast: Forecaster confidence in the subjective feeling a TDO has about his knowledge of where a cyclone is now, where it has been and where it is going. The following values were suggested from the 1968 season:

1st three warnings (no good 12 hour history)	150 N.M.
20 to 30 knot winds at forecast time	120 N.M.
Northeasterly movement	140 N.M.
Best confidence limit	40 N.M.
Worst confidence limit	200 N.M.

The original impetus for this study was the understand-

able desire to express statistically the increased confidence that was believed to accompany the reduction in forecasting error noted in the last few years thus enabling closer passage by mobile operating forces to tropical cyclones when forecaster confidence was better than average.

3. ANALYSIS:

a. General: Only the subjective method was significantly better than the other four methods tested. On the whole, forecasters' subjective estimates tended to be conservative, averaging 9 N.M. greater than observed mean error. Seventy-five percent (75%) of the confidence forecasts verified with errors no more than 20 N.M. greater than the forecast value. This figure compares with seventy-six point-five percent (76.5%) that would have verified under the same ground rules using a mean error value of 105 N.M. for all forecasts. The second method approximates the manner of applying confidence implied in current SEVENTH FLEET Operations Orders and presents a fair argument for retention of the present doctrine.

The relatively poor performance of the error forecasts by geographic area of origin is undoubtedly due in part to the limited sample size of the error climatology. Whenever 1968 error history was not available the mean value for 1968 was substituted. The relatively poor final performance of the area climatology, both mean values per 2 1/2 degree square and three category assignment, indicates negative correlation between forecast errors in the same geographic location from one year to the next. A tentative hypothesis for these data is that geographic errors are less significant than dynamic errors associated with storm intensity, speed of motion, direction of motion and its relation to large scale synoptic features of current weather charts. The expansion of error climatology based on geographic area would eventually produce a forecast showing some skill due to a concentration of storms with similar characteristics in the same area, but a more direct approach considering the dynamics of intensity or speed and direction of motion should be superior meteorologically.

The poorest of the objective methods is the persistance forecast. The results here indicate that large errors or small errors are unlikely to repeat themselves over a 48 hour period and also that forecasting of extreme values results in larger errors than forecasting mean values. We must conclude with some conviction that yesterdays performance is less indicative of todays confidence than is last years mean error value.

Even though the mean value of subjective forecaster confidence shows little skill over last years single mean value, the possibility of skill in one or more confidence categories is worth investigating.

b. Better Than Average Confidence (25 N.M. or less): Forecasts of good confidence are useful if (1) they can be reliably made and (2) they can result in a significant change in operational decisions. Relative to the first criterion, 12 of 49 confidence forecasts (24% of better than average confidence (85 N.M. or less) verified with greater than average error (135 N.M. or more.) From this we might describe a 76 percent confidence level that our forecast of "better than average" will verify as "average" or "better than average." Relative to the second criterion the best confidence used during the period was 50 N.M. The median error of the confidence forecast was 42 N.M. An operational decision at the 75 percent confidence level would thus involve the difference between a single mean error of 105 N.M. and the adjusted subjective forecast of 92 N.M. A maximum reduction of a "clearance criterion" for tropical storms of only 12 percent or 13 N.M. would result. Any of the 12 "bust" forecasts from the "better than average" forecast group might have encouraged a closer approach than would otherwise be considered prudent to the subsequent track of a typhoon if the confidence forecast were used in determining an evasion course. It is doubtful if the potentially small gain justifies the loss of confidence level.

c. Average Confidence (90 to 130 N.M.): One hundred five (105) of the two hundred five (205) forecasts in the sample were forecasted to be in the average range (90 to 130 N.M.) and only 21 of them (20%) verified with greater than average error. One would normally expect many more "bust" forecasts from the average confidence group than from the better than average group if predictable skill were involved.

d. Below Average Confidence (135 N.M. to 200 N.M.): Twenty-four (24) of fifty-one (51) below average confidence forecasts (47%) verified correctly in the above average error group suggesting considerable skill in the recognition of large error potential at the time of forecast. Even when circumstances of missing or questionable data create doubt in the forecasters mind and lead him to anticipate large potential errors, persistence works toward verifying a conservative extrapolation forecast. Verification of an expected large error with better than average accuracy is no indication of lack of forecaster skill. On the contrary it indicates that a difficult situation was recognized and correctly forecasted. The greater frequency of large errors in cases where they are expected would be valuable information to the Captain desiring to exercise all caution due an uncertain forecast of hazardous weather.

4. CONCLUSIONS:

a. Confidence as a forecast parameter is subject to the same range of inaccuracies experienced with other forecast parameters.

b. The best method of forecasting confidence found in the initial project was the subjective opinion of the forecaster.

c. The only occasion when a subjective confidence forecast showed significant skill was when large errors were anticipated.

G. Fujiwhara Effect - Case Studies.

1. INTRODUCTION:

There are many problems to be faced in tropical cyclone movement forecasting. One of these, which occurs only seldom but which is capable of injecting exceptionally high errors into movement forecasts, is the interaction of vortex centers with one another. This is often referred to as a demonstration of the Fujiwhara effect in honor of the first primary investigator of this phenomenon. This interaction or Fujiwhara effect is characterized by a cyclonic rotation of two vortex centers about some point located along a line connecting their two centers. This rotation is usually co-existant with a mutual attraction of the two vortex systems. The combined effects of rotation and attraction greatly affect forecast accuracy, since cyclone behavior deviates sharply from normal under these conditions.

Before forecast improvement can be achieved through practical application to compensate for the Fujiwhara effect, a better understanding of cyclone behavior under influence of binary interaction is necessary. To aid in this understanding, research was conducted on two cases of previous cyclone interaction. These cases were picked at random with the hope of obtaining cases representative of most occurrances.

Individual cyclone movement was investigated to see if it was feasible to combine cyclone rotation rates and some form of translation of a point common to both cyclones to obtain a reasonable estimate of actual individual cyclone speed of movement.

The first case investigated was that of Typhoons Kathy and Marie during the period 14/0000Z through 19/0000Z August 1964 (See Figure 3-7). The second case was that of Typhoons Marge and Nora during the period 24/1200Z through 28/1200Z August 1967 (See Figure 3-8).

The first case appeared to be a more classical example of binary cyclone interaction than the second case, but there was a definite interaction of the two cyclones in the second case also.

2. PROCEDURE:

The two cyclone tracks within each case were plotted on the same chart so that a visual representation of their relative interaction could be observed. Lines were drawn between each of the cyclone tracks connecting locations at corresponding times, so that angles of rotation could be determined. A midpoint between the cyclones along each connecting line was determined.

Though the use of the midpoint as the rotation pivot is a very simple method, it does not consider relative sizes of the interacting cyclones. Therefore a second set of rotation points was obtained to include a relative size factor. Many authors have theorized that rotation during binary cyclone interaction occurs about a point corresponding to the center of mass of the two interacting systems. Mass of any meteorological system is a very vague term and one which is hard to define. To incorporate this theory into an actual study, a previously suggested method using a maximum wind speed ratio was utilized using the following formula;

$$d_1 = \frac{DV_2}{V_1 + V_2} \qquad [1]$$

where

d_1 is the center of mass location from cyclone 1.

D is the total separation distance of the two cyclones.

V_2 is the maximum wind speed of cyclone 2.

V_1 is the maximum wind speed of cyclone 1.

By using these two points, the midpoint and the center of mass point, rates of rotation were determined. Afterward the translation speeds of these points of rotation were added with the rotation speed in hopes that a good approximation of actual cyclone speed could be determined. A twelve hour time period was used for all calculations. The following formulae were used:

$$S = S_r + S_t \qquad [2]$$

$$S_r = 1.4X10^{-3} \alpha \bar{r} \quad \text{(for 12 hour period)} \qquad [3]$$

$$S_t = D^*/12 \quad \text{(for 12 hour period)} \qquad [4]$$

where S: total speed of movement

S_r: speed of movement resulting from rotation.

S_t: speed of movement resulting from translation of the point of rotation.

α : angle of rotation over the 12 hour period.

$\bar{r}$: the average radius of rotation.

D*: distance point of rotation moves in 12 hours.

NOTE: Direction of movement of the point of rotation relative to the direction of the cyclone rotation was not considered in calculated movement speeds.

3. DISCUSSION:

An analysis of the movement speed calculated by both the center of mass and the midpoint methods showed that in general the computed speed of movement was more accurate for the northernmost cyclone. The computed values for speed of movement for the southernmost cyclone were generally too high (See Figures 3-9 and 3-10).

One cyclone investigated, Typhoon Nora, fit these general observations but the calculated speeds were exceptionally unrealistic up to 27/0000Z. After that time calculated values compared favorably with the actual cyclone speed. At that time Nora became the northernmost cyclone of the pair and also began to show a slow intensification. This large error was probably caused by the fact that prior to 27/0000Z, Nora was just forming and moving very slowly. Her strength was only 20 knots or less during this period and she appeared to be no more than a weak, but well organized, tropical low.

Investigation of Case I (Typhoons Kathy and Marie) indicated that for Typhoon Kathy the center of mass point of rotation method gave exceptionally good results for the entire interaction period with an average error of only 1.5 knots. This was an average percentage of error of 27%. For Kathy the midpoint method gave good results also with an average error of 2.5 knots representing an average percentage of error of 36%.

For both methods, one time period was characterized by an unreasonable error. Estimated speeds for Kathy during the 12 hour period 17/1200Z to 18/0000Z were calculated as 7.5 knots and 7.1 knots for the center of mass method and the midpoint method respectively. During this time period Kathy was moving south, becoming the southernmost cyclone after previously being the northernmost cyclone. During this time the direction of rotation was perpendicular to the point of rotation movement therefore the rotation speed alone should have given the best estimation of the actual movement speed. The rotation speeds for the center of mass method and the midpoint method were 5.6 knots and 6.8 knots, respectively. These compared more favorably to the actual movement speed of 4 knots.

The average results for Typhoon Marie were comparable to the results obtained for Kathy with an average error of 2.7 knots when the midpoint method was used. This corresponded to an average percent of error of 32.9%. When the center of mass method was used a much greater average error of 5.9 knots and an average percent of error of 60.6% was obtained. A look at Figure 3-9 shows that after 17/0000Z the errors for the midpoint method decreased and remained fairly accurate. At that same time the center of mass method increased in accuracy but

after 18/0000Z the accuracy decreased significantly. It was found that for every time there were poor comparisons the cyclone was either moving at large angles to or in the opposite direction to the movement of the rotation point. This indicates that a component of the point of rotation movement speed relative to the direction of movement of the cyclone should be considered in order to achieve the best results.

It was also observed that the original northernmost cyclone actually slowed to a minimum movement speed about 6 to 12 hours after the calculated speeds of both the midpoint and the center of mass methods indicated a minimum in speed. At the time the two interacting cyclones became east and west of each other the cyclone moving south tended to slow sharply in movement while the cyclone moving north began to accelerate. Shortly before this the point of rotation either slowed in movement speed or became erratic in movement.

Investigation of Case II (Typhoons Marge and Nora) indicated that the midpoint method gave slightly better results for both cyclones considered together, but neither method gave good results for Nora until 27/0000Z. As mentioned earlier, before this time Nora was only a weak developing tropical low and as such her movement is considered unrepresentative of normal cyclone movement under Fujiwhara effects.

Excluding the results for Typhoon Nora, the comparison of actual versus computed speeds of movement for this case compared favorably with those of Case I. The speeds of movement calculated for Typhoon Marge indicated that the center of mass method gave slightly better results for the overall investigated time interval. The center of mass method gave an average error of 2.3 knots as compared to 2.5 knots for the midpoint method. The corresponding average percents of error were 31.2% and 38.7%, respectively (See Table 3-10). The midpoint method gave exceptionally good results during the first part of the investigation period up to 27/1200Z with an average error of 1.0 knots and an average percent of error of 8.4%. Both methods were very good until 27/0000Z.

After 27/0000Z, Marge became the southernmost cyclone as the two cyclones slowly rotated. After that time the cyclone's movement was perpendicular to or in the opposite direction of the rotation point movement. This case, therefore, also indicates that more accurate results could be obtained by using the component part of the rotation point movement corresponding to the cyclone movement.

Although Nora was very weak during the initial time period of this case study, she evidently had some definite influence on the movement of Typhoon Marge. Nora was too weak in comparison to Marge to ever cause a full rotation but she was able to alter the track and speed of Marge (See Figure 3-8). At the time when Nora moved north of Marge's 090^{o} bearing, attraction of the two cyclones seemed to cause a rapid decelera-

tion of Marge and shortly thereafter Marge experienced a change in direction to a north of west course.

As noticed in Case I, the points of rotation for Case II slowed in movement or changed direction abruptly approximately 6 to 12 hours preceding a decrease in the speed of movement of the cyclone moving toward the south. (See Figure 3-10.)

The angle of rotation (α) is one of the major variables contributing to the estimation of a cyclone speed of movement while experiencing Fujiwhara effect. Since little is known about what elements cause significant changes in values of α, a short investigation of its characteristics evident in these two case studies was conducted. It appears that there is some influence on α caused by changes in intensity differences of the two interacting cyclones and changes in the average distance of separation. An investigation of this variance of α in relation to values of intensity differences compared with cyclone separation indicated that an increase in α occurs with a decrease in separation distance and an increase in the intensity difference of the two cyclones. It also appears that very little rotation occurs at separation distances greater than 600 or 700 N.M. no matter what the intensity difference is. See Figure 3-11.

4. CONCLUSION:

The results of this research indicate that cyclone speed of movement during interaction can be closely approximated by theoretical calculations which combine the rotational effect of the cyclones and the translation of the point of rotation.

Results were exceptionally good when the cyclone was moving in the same direction as the point of rotation. It was also noticed that when a cyclone was moving in an opposite direction to that of the rotation point better results were achieved by subtracting the translation speed of the rotation point. For inbetween cases, such as when the cyclone was moving at angles to the direction of movement of the rotation point, calculated speeds would be improved by adding or subtracting only that component of movement speed of the rotation point that corresponded to the direction of movement of the cyclone.

Consideration of cyclone intensity by using the center of mass method was necessary only for cases of excessive difference in the intensity of two cyclones. Even for excessive intensity differences the midpoint method will generally give satisfactory results.

By using the translation of the point of rotation as a contributor to the cyclone speed of movement, we are assuming that the speed of movement of the rotation point is in direct proportion to the steering flow. We are also assuming that the steering flow is homogeneous for the entire rotating system, which requires the horizontal shear to be zero. This is a

tenuous assumption since horizontal shears are seldom zero over an area as large as that representing these rotating systems. Therefore it must be concluded that the presence of excessive or large horizontal shears can definitely inject significant errors into speed calculations.

It was noticed during analysis of computed cyclone movement speeds and the corresponding actual cyclone movement speeds that at the time the points of rotation began to slow in translation speed or became erratic in movement, the cyclone pairs reacted much in the same manner for both cases. At the time the point of rotation began to slow or became erratic, the cyclone moving toward the south slowed in movement within the following 6 to 12 hour period while the cyclone moving north began to increase in speed of movement within the next 6 to 12 hours. After firm substantiation by investigation of several more cases, this observed reaction could prove beneficial in the short range forecasting of changes in cyclone speed of movement of two interacting cyclones.

There are definite possibilities for future use of binary cyclone interaction theories for assisting in forecasting movements of interacting cyclones but considerably more research is needed before a reliable forecast tool evolves. From equations [2], [3], and [4], we can see that if S_r and S_t can be predicted with reasonable accuracy for a period of time, say 12 hours, then an average speed of movement of the cyclone can be obtained for that 12 hour period. Keep in mind that a component of S_t would have to be added or subtracted from S_r, depending upon an estimated direction of movement for the cyclone in question. It appears that a reasonable answer could be reached simply by adding S_t to S_r for a westward moving cyclone and subtracting S_t from S_r for an eastward moving cyclone.

Now that the use of the predicted S_r and S_t is necessary, we come to the perplexing problem of how a prediction of S_r and S_t can be reached. Although not researched in this study, it appears that a reasonable value for S_t could be reached by steering the rotation point with the integrated steering flow much as would be done for forecasting the movement of a single cyclone. (The possible errors in using this method were suggested earlier when discussing the assumption of a horizontally homogeneous atmosphere over the interacting system). Prediction of S_t is difficult enough but the prediction of S_r at this state of the art is even more difficult. From equation [3] it is noticed that a value for S_r is dependent upon the angle of rotation for a predetermined time period (α) and upon the average radius of rotation ($\bar{r}$). A reasonable value for $\bar{r}$ can be reached by forecasting the expected distance separating the two cyclones, considering mutual attraction, and if desired, by also using an estimated intensity of each cyclone. A prediction method for α is the major "weak link" in the chain. Present knowledge of the mechanisms causing significant changes in the rotation rates remains at a rather primitive level.

It may be possible in the future to obtain a reasonable approximation for the angle of rotation from a graph similar to that in Figure 3-11. For this to be feasible, investigation of many more case studies will be required to increase the density of data points to obtain consistently reliable estimates of the angle of rotation.

As a result of this investigation, it is definitely indicated that cyclone movement during interaction can not be fully explained or forecasted by the use of simple techniques, but continued research in this area has good potential for assisting in lowering errors in the forecasting of tropical cyclone movement.

MOVEMENT ERROR (CALCULATED VS. ACTUAL)

		MIDPOINT		CENTER OF MASS	
		Average Error	Average % Error	Average Error	Average % Error
CASE I	Kathy	2.5 kts	36.0%	1.5 kts	26.5%
	Marie	2.7 kts	32.9%	5.9 kts	60.6%
CASE II	Marge	2.5 kts	38.7%	2.3 kts	31.2%
	Nora	7.7 kts	223.5%	11.4 kts	361.5%

TABLE 3-10

REFERENCES:

1. Annual Typhoon Report, U. S. Fleet Weather Central/Joint Typhoon Warning Center, Guam, 1964 and 1967.

2. Brand, Samson, Interaction of Binary Tropical Cyclones of the Western North Pacific Ocean, NAVWEARSCHFAC Technical Paper No. 26-68, Norfolk, Va., 1968.

3. Riehl, H., Tropical Meteorology, McGraw-Hill Book Company, Inc., New York, 1954, Pg. 345-347.

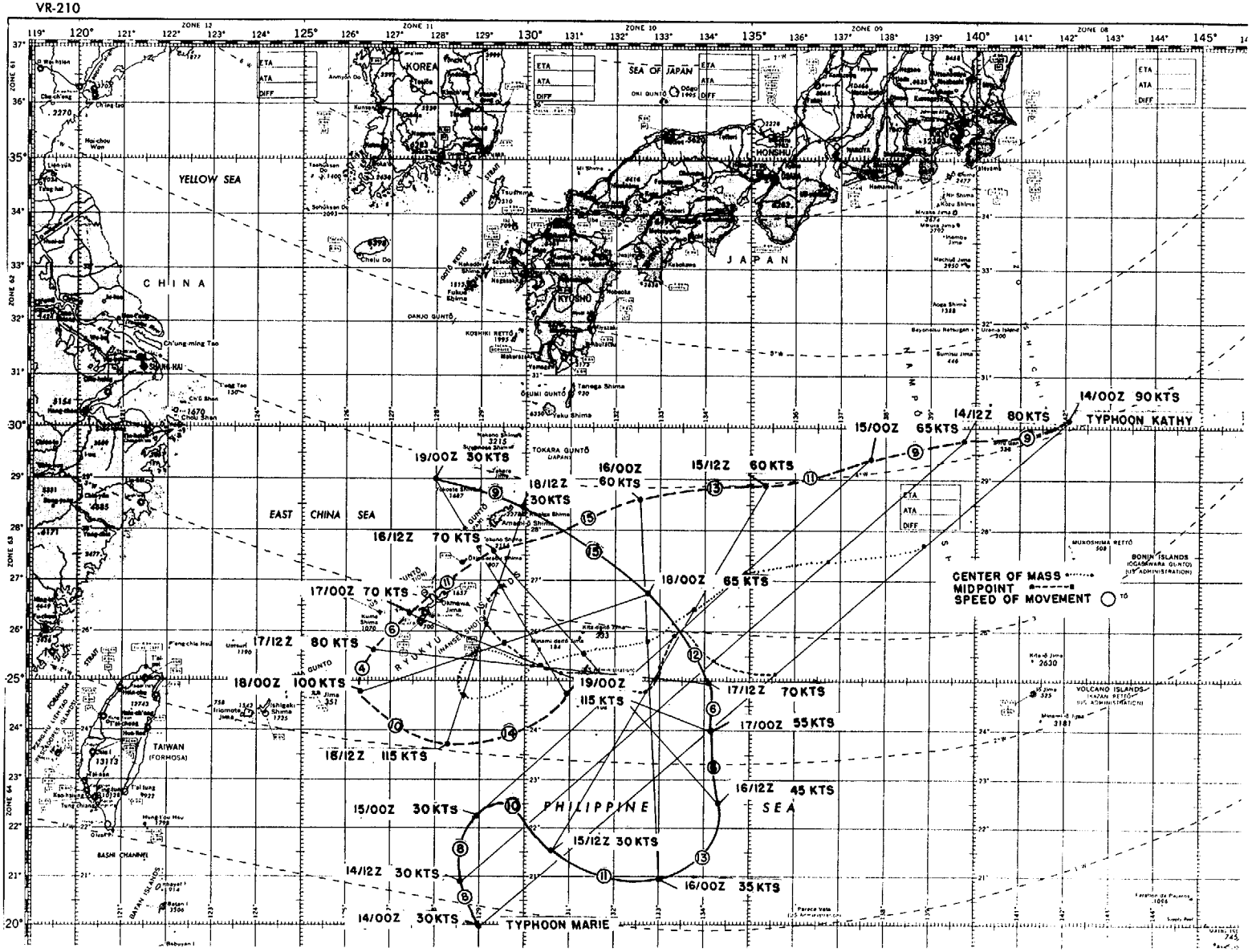

KOREA
SEA OF JAPAN
JAPAN
HONSHU
KYUSHU
YELLOW SEA
CHINA
EAST CHINA SEA
TAIWAN (FORMOSA)
PHILIPPINE SEA
19/00Z 30 KTS
18/12Z 30 KTS
16/00Z 60 KTS
15/12Z 60 KTS
15/00Z 65 KTS
14/12Z 80 KTS
14/00Z 90 KTS
TYPHOON KATHY
16/12Z 70 KTS
17/00Z 70 KTS
17/12Z 80 KTS
18/00Z 100 KTS
18/00Z 65 KTS
19/00Z 115 KTS
17/12Z 70 KTS
17/00Z 55 KTS
16/12Z 115 KTS
16/12Z 45 KTS
15/00Z 30 KTS
15/12Z 30 KTS
16/00Z 35 KTS
14/12Z 30 KTS
14/00Z 30 KTS
TYPHOON MARIE
CENTER OF MASS
MIDPOINT
SPEED OF MOVEMENT

FIGURE 3-7

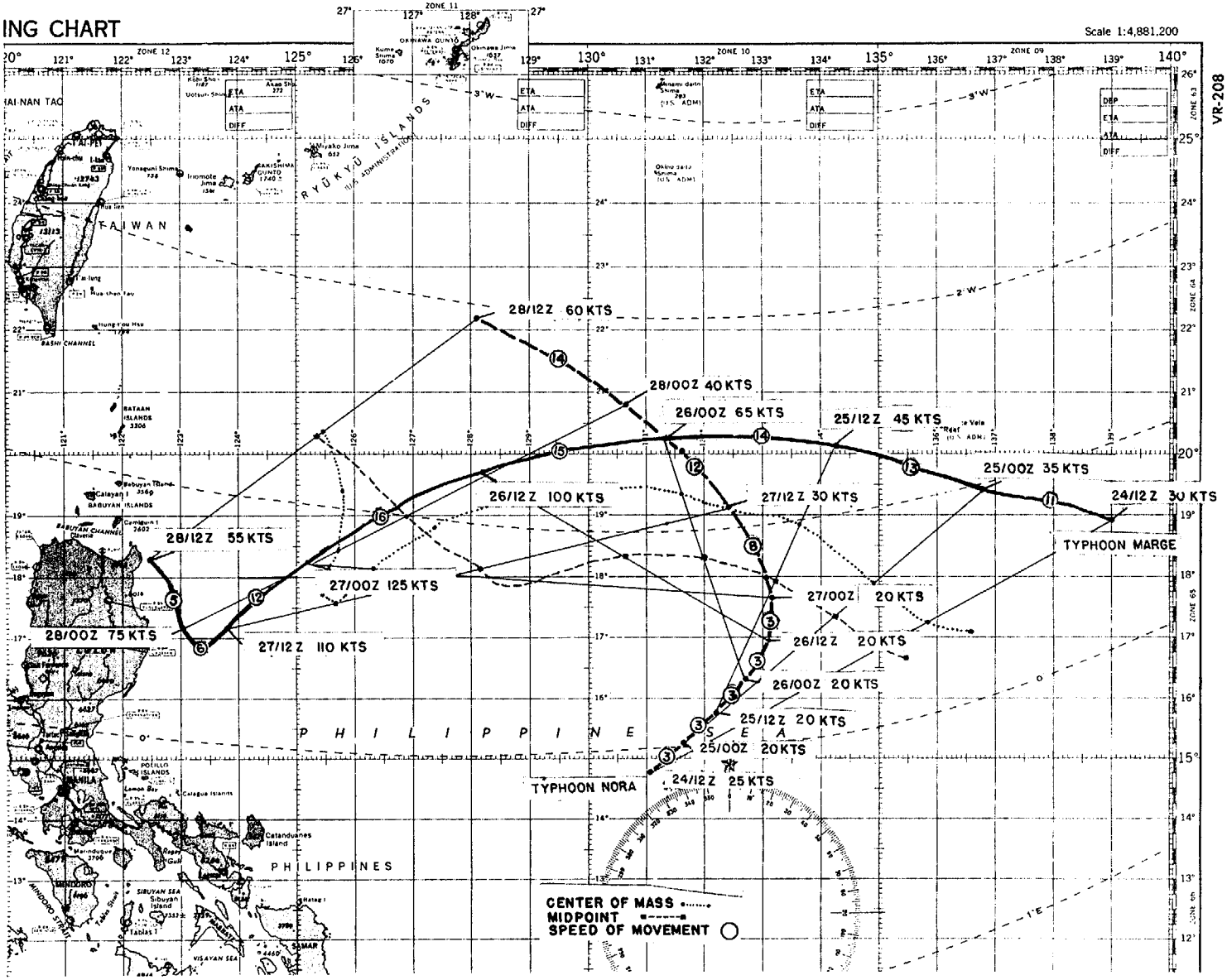
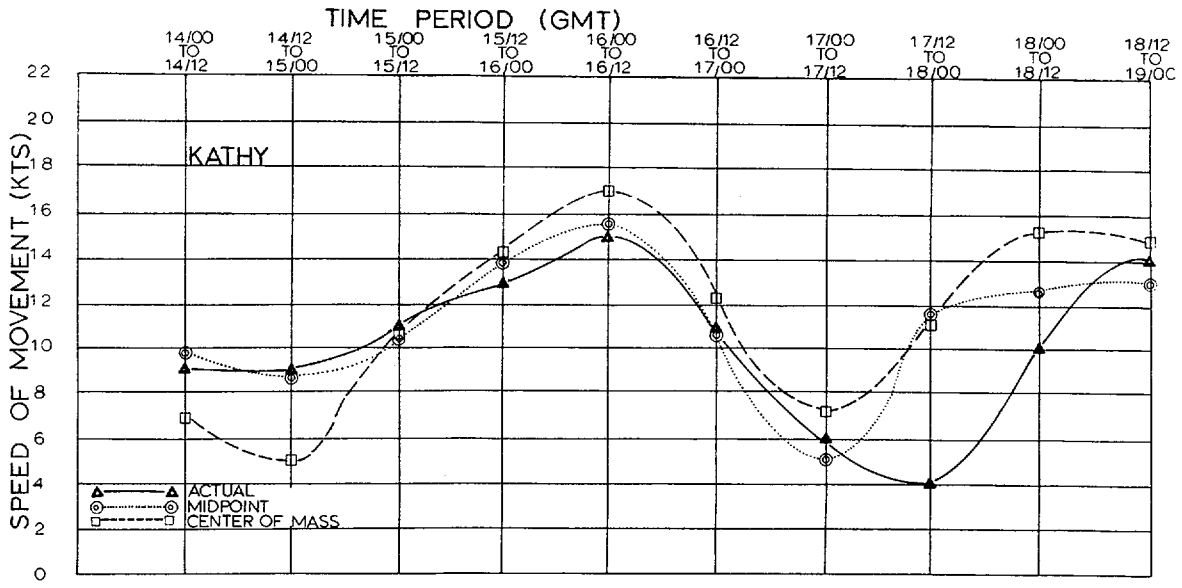

ING CHART
Scale 1:4,881,200
VR-208
28/12Z 60 KTS
28/00Z 40 KTS
26/00Z 65 KTS
25/12Z 45 KTS
25/00Z 35 KTS
24/12Z 30 KTS
TYPHOON MARGE
26/12Z 100 KTS
27/12Z 30 KTS
28/12Z 55 KTS
27/00Z 125 KTS
27/00Z 20 KTS
28/00Z 75 KTS
27/12Z 110 KTS
26/12Z 20 KTS
26/00Z 20 KTS
25/12Z 20 KTS
25/00Z 20KTS
24/12Z 25 KTS
TYPHOON NORA
RYUKYU ISLANDS
TAIWAN
PHILIPPINE SEA
PHILIPPINES
CENTER OF MASS
MIDPOINT
SPEED OF MOVEMENT

FIGURE 3-8


TIME PERIOD (GMT)
14/00 TO 14/12
14/12 TO 15/00
15/00 TO 15/12
15/12 TO 16/00
16/00 TO 16/12
16/12 TO 17/00
17/00 TO 17/12
17/12 TO 18/00
18/00 TO 18/12
18/12 TO 19/00
KATHY
SPEED OF MOVEMENT (KTS)
0
2
4
6
8
10
12
14
16
18
20
22
ACTUAL
MIDPOINT
CENTER OF MASS

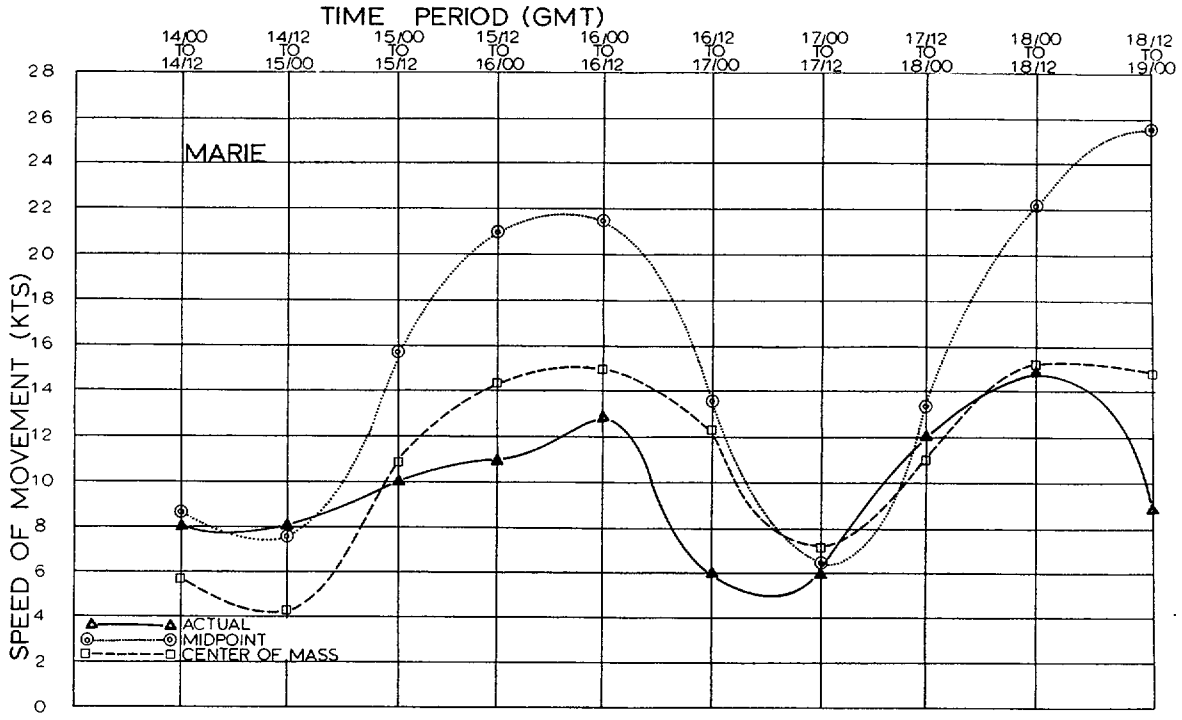
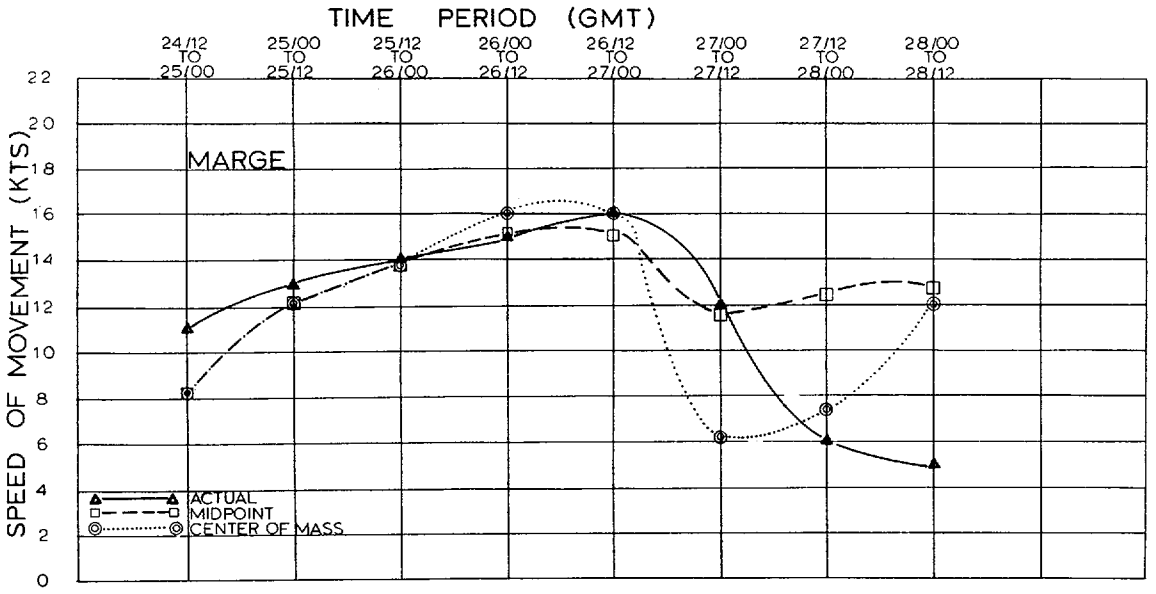

TIME PERIOD (GMT)
14/00 TO 14/12
14/12 TO 15/00
15/00 TO 15/12
15/12 TO 16/00
16/00 TO 16/12
16/12 TO 17/00
17/00 TO 17/12
17/12 TO 18/00
18/00 TO 18/12
18/12 TO 19/00
MARIE
SPEED OF MOVEMENT (KTS)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
ACTUAL
MIDPOINT
CENTER OF MASS

FIGURE 3-9


TIME PERIOD (GMT)
24/12 TO 25/00
25/00 TO 25/12
25/12 TO 26/00
26/00 TO 26/12
26/12 TO 27/00
27/00 TO 27/12
27/12 TO 28/00
28/00 TO 28/12
MARGE
SPEED OF MOVEMENT (KTS)
0
2
4
6
8
10
12
14
16
18
20
22
ACTUAL
MIDPOINT
CENTER OF MASS

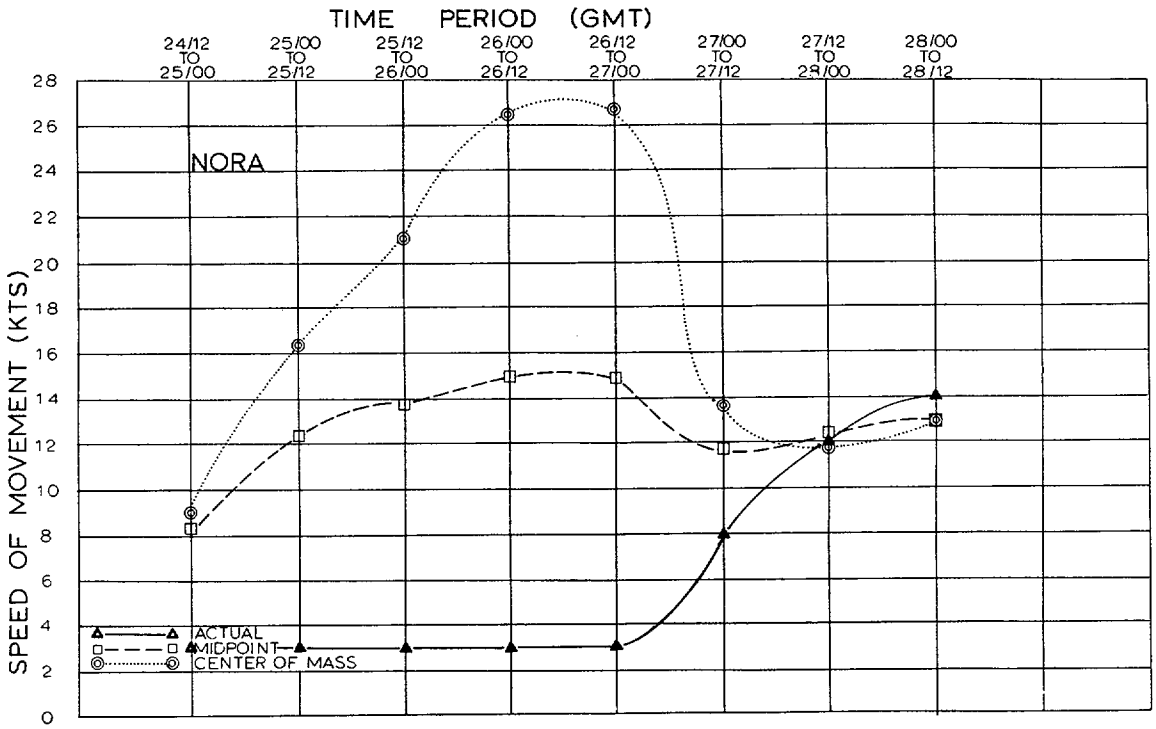

TIME PERIOD (GMT)
24/12 TO 25/00
25/00 TO 25/12
25/12 TO 26/00
26/00 TO 26/12
26/12 TO 27/00
27/00 TO 27/12
27/12 TO 28/00
28/00 TO 28/12
NORA
SPEED OF MOVEMENT (KTS)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
ACTUAL
MIDPOINT
CENTER OF MASS

FIGURE 3-10

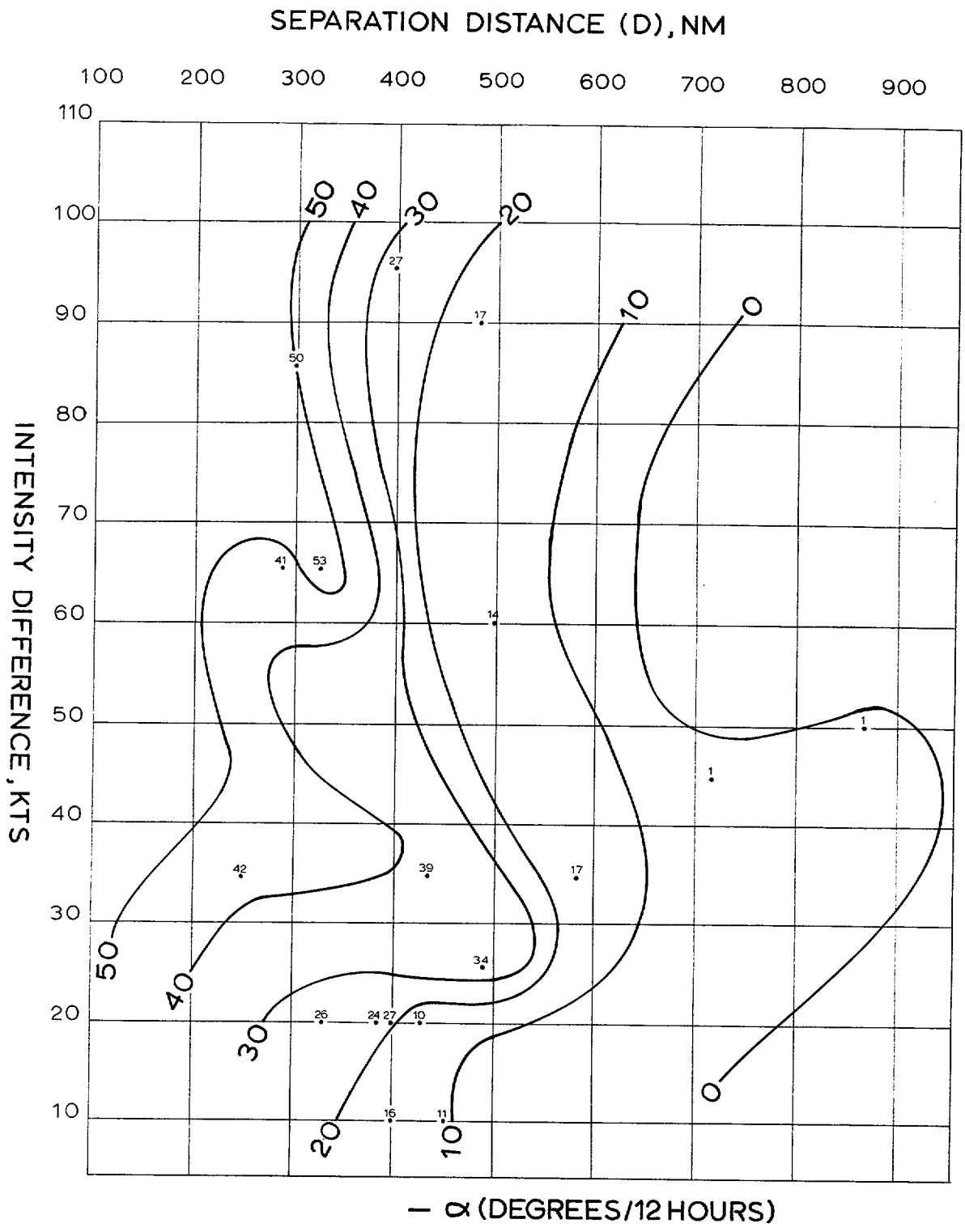

SEPARATION DISTANCE (D), NM
100
200
300
400
500
600
700
800
900
110
100
90
80
70
60
50
40
30
20
10
INTENSITY DIFFERENCE, KTS
50
40
30
20
10
0
27
17
50
41
53
14
1
1
42
39
17
34
26
24
27
10
16
11
— α (DEGREES/12 HOURS)

FIGURE 3-11

H. Climatology

1. TYPHOON FREQUENCY:

Typhoon frequency climatology was slightly decreased by the small number of occurrances experienced this season. The average annual typhoon frequency decreased from 20.6 at the end of the 1968 season to 19.9 at the end of this season (See Table 3-11).

2. TYPHOON DISTRIBUTION:

Figure 3-12 depicts the typhoon distribution of 347 typhoons which have been detected over the past 18 year interval. Notice that the months of high formation probability remain the months of July through November after the inclusion of 1969 typhoon data.

TYPHOON FREQUENCY
11 YEAR PERIOD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
1959	0	0	0	1	0	0	1	5	3	3	2	2	17
1960	0	0	0	1	0	2	2	8	0	4	1	1	19
1961	0	0	1	0	2	1	3	3	5	3	1	1	20
1962	0	0	0	1	2	0	5	7	2	4	3	0	24
1963	0	0	0	1	1	2	3	3	3	4	0	2	19
1964	0	0	0	0	2	2	6	3	5	3	4	1	26
1965	1	0	0	1	2	2	4	3	5	2	1	0	21
1966	0	0	0	1	2	1	3	6	4	2	0	1	20
1967	0	0	1	1	0	1	3	4	4	3	3	0	20
1968	0	0	0	1	1	1	1	4	3	5	4	0	20
1969	1	0	0	1	0	0	2	3	2	3	1	0	13
AVG	.2	0	.2	.8	1.1	1.1	3.0	4.5	3.3	3.3	1.8	.7	19.9

TABLE 3-11

18 YEAR MONTHLY DISTRIBUTION OF 347 WESTERN PACIFIC TYPHOONS 1952 — 1969

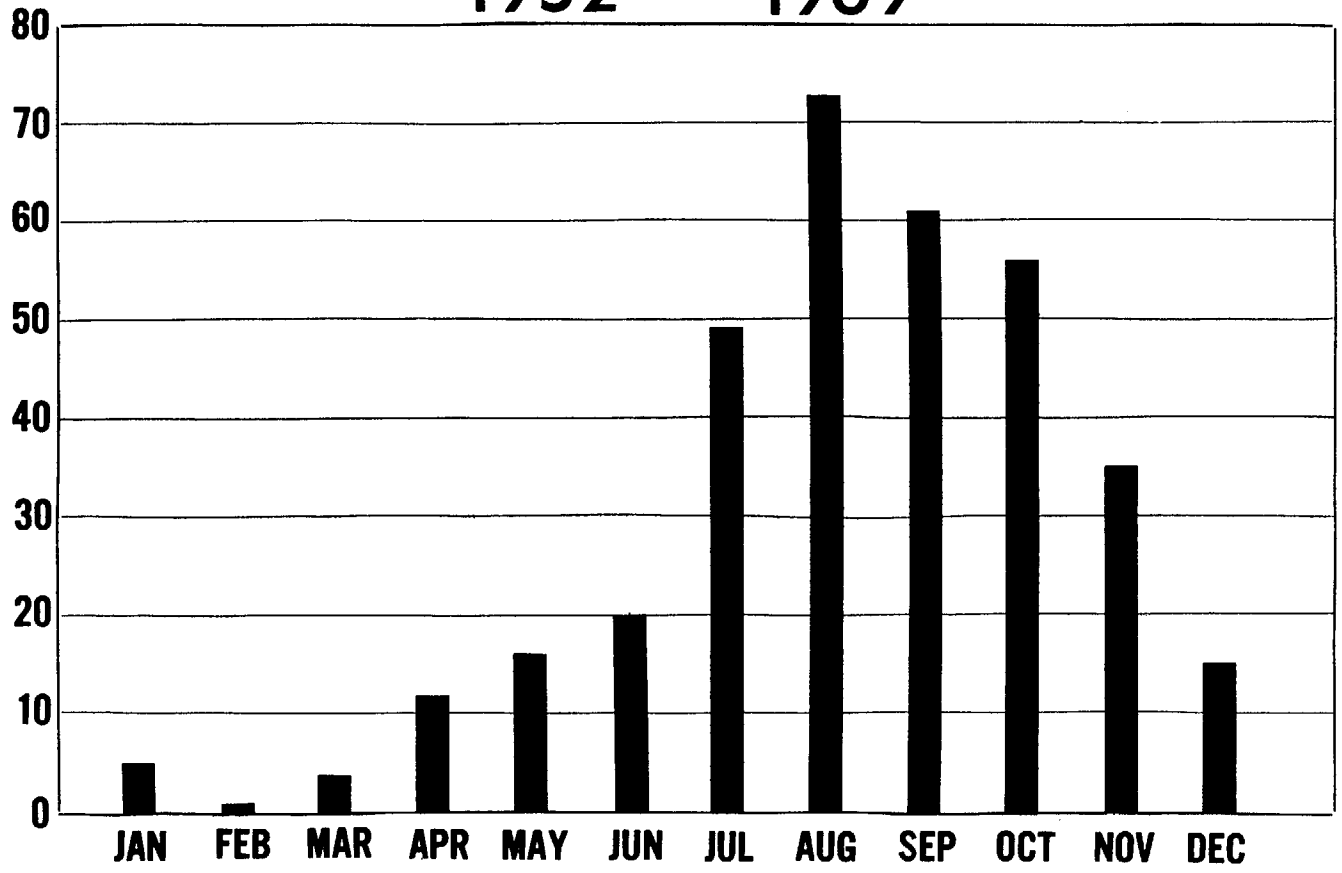


FIGURE 3-12

I. Satellite Data Fix Accuracy.

1. BACKGROUND:

A study of satellite fix accuracy was presented in the 1966 Annual Typhoon Report. Since that time a new generation of space hardware and improved technology have been developed. This study was made to reflect any improvements in terms of fix data reliability.

2. METHOD:

Satellite bulletin fix positions were compared to the JTWC best track positions for the time of the satellite fixes. Results are reported in Table 3-12.

SATELLITE POSITION ERROR (N.M.)

	1965	1966	1969
NUMBER OF CASES	75	71	75
AVERAGE ERROR	81	49	39
MEDIAN ERROR	55	39	34
RANGE OF ERROR	0-425	5-219	5-105

TABLE 3-12

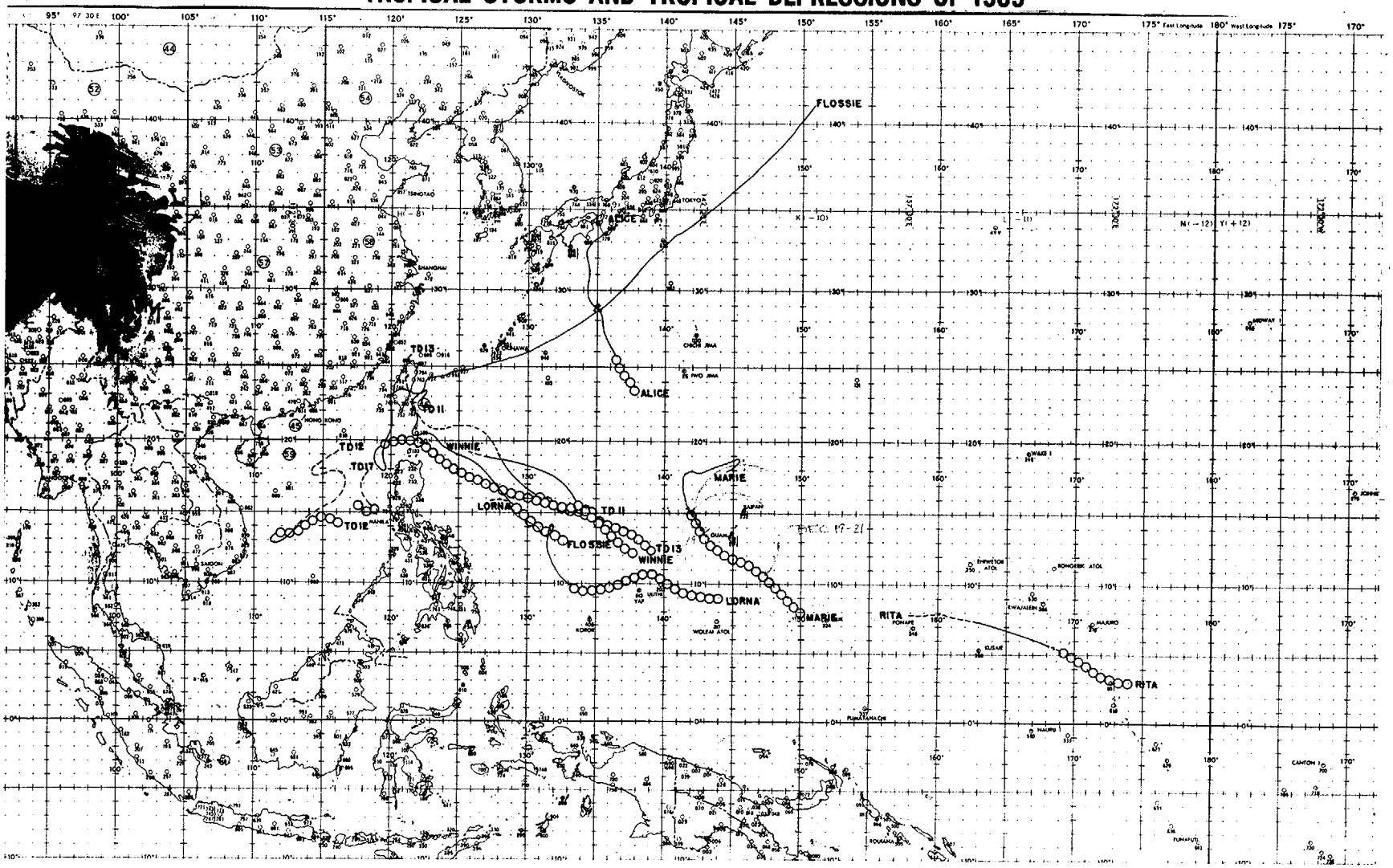
3. CONCLUSIONS:

Slight improvement since 1966 is indicated, however, 1969 figures were limited to storms whose best track wind velocities were 35 knots or greater. This eliminates the main source of disproportionately high errors during the formative stages and may account for some apparent gain in accuracy. The 1969 mean and median position errors represent the practical total resolution presently available from satellite systems relative to location of tropical cyclones.

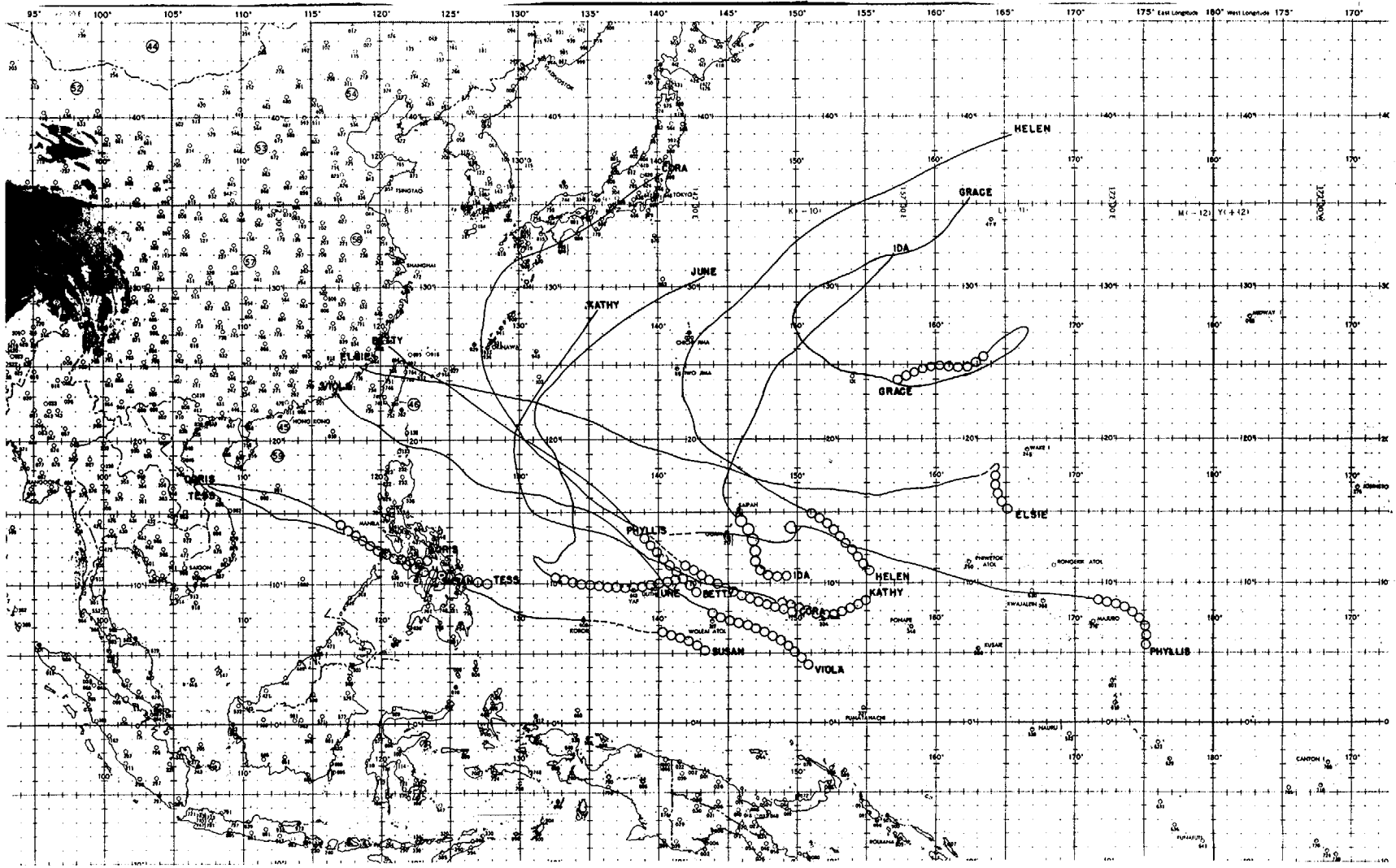
CHAPTER IV

SUMMARY OF TROPICAL CYCLONES 1969

TROPICAL STORMS AND TROPICAL DEPRESSIONS OF 1969



TYPHOONS OF 1969



SUMMARY OF WESTERN PACIFIC TROPICAL CYCLONES OF 1969

During 1969, the Joint Typhoon Warning Center issued 430 warnings on 13 typhoons, 6 tropical storms and 4 tropical depressions while in a warning status for 108 days. When compared with previous years, it is evident that 1969 was an unusually inactive year.

There were no tropical cyclones passed to JTWC from outside its area of responsibility and JTWC passed no tropical cyclones to other agencies.

There were two "Super Typhoons" (maximum sustained surface wind of 130 knots or greater) during the 1969 season compared with five in 1968 and four in 1967. Typhoon Elsie registered a 890 MB center pressure which is one of the lowest ever recorded in the Western Pacific.

The following figures and tables are provided to present representative statistical data from the 1969 tropical cyclone season and provide a ready reference for comparison with previous years.

SUMMARY OF WESTERN PACIFIC
TROPICAL CYCLONES
OF 1969

	1960-1967 (AVE)	1968	1969
TOTAL NUMBER OF WARNINGS	781	822	430
CALENDAR DAYS OF WARNING	160	142	108
NUMBER OF WARNING DAYS WITH TWO OR MORE CYCLONES	59	68	15
NUMBER OF WARNING DAYS WITH THREE OR MORE CYCLONES	15	15	1
TROPICAL DEPRESSIONS	6	4	4
TROPICAL STORMS	11	7	6
TYPHOONS	21	20	13
TOTAL TROPICAL CYCLONES	38	31	23

TABLE 4-1

SUPER TYPHOONS DURING 1969*

CYCLONE NUMBER	NAME	INCLUSIVE DATES	MAX INTENSITY	MIN SLP	MIN 700 MB HT
05	VIOLA	21 - 28 JUL	130 KNOTS	897 MB	2137 m
14	ELSIE	19 - 27 SEP	150 KNOTS	890 MB	2140 m

* Typhoons with maximum sustained surface winds of 130 knots or greater.

TABLE 4-2

1969 TROPICAL CYCLONES

CYCLONE	TYPE	NAME	DATE*	CALENDAR DAYS OF WARNING	MAX SFC WND*	MIN OBS SLP	MAX RADIUS SFC CIRC	WARNINGS ISSUED TOTAL	WARNINGS ISSUED NO. AS TYPHOONS	DISTANCE TRAVELED*
01	T	PHYLLIS	17 JAN-22 JAN	6	85	966	240	24	15	1968
02	TS	RITA	07 MAR-09 MAR	3	40	993	300	12	0	684
03	T	SUSAN	18 APR-25 APR	8	105	943	240	29	12	882
04	T	TESS	08 JUL-11 JUL	4	70	974	300	13	3	906
05	T	VIOLA	21 JUL-28 JUL	8	130	897	420	26	18	1854
06	TS	WINNIE	29 JUL-31 JUL	3	45	984	240	07	0	480
07	TS	ALICE	02 AUG-04 AUG	3	45	982	300	10	0	678
08	T	BETTY	05 AUG-08 AUG	4	70	962	360	14	4	1242
09	T	CORA	14 AUG-23 AUG	10	85	948	330	34	15	2226
10	T	DORIS	31 AUG-02 SEP	3	65	973	240	9	3	612
11	TD		07 SEP-11 SEP	5	30	990	180	18	0	648
12	TD		07 SEP-08 SEP	2	25	996	120	05	0	174
13	TD		11 SEP-12 SEP	2	30	996	150	04	0	216
14	T	ELSIE	19 SEP-27 SEP	9	150	890	600	34	26	2760
15	TS	FLOSSIE	29 SEP-05 OCT 08 OCT-09 OCT	9	60	956	270	32	0	2598
16	T	GRACE	29 SEP-06 OCT	8	95	937	300	29	21	2172

TABLE 4-3

1969 TROPICAL CYCLONES (Cont'd)

CYCLONE	TYPE	NAME	DATE*	CALENDAR DAYS OF WARNING	MAX SFC WND*	MIN OBS SLP	MAX RADIUS SFC CIRC	WARNINGS ISSUED TOTAL	WARNINGS ISSUED NO. AS TYPHOONS	DISTANCE TRAVELED*
17	TD		30 SEP	1	30	997	120	02	0	42
18	T	HELEN	08 OCT-12 OCT	5	105	930	330	20	10	2340
19	T	IDA	15 OCT-22 OCT	8	115	917	360	26	17	1296
20	T	JUNE	28 OCT-05 NOV	9	105	936	500	33	21	1782
21	T	KATHY	03 NOV-08 NOV	6	110	930	420	24	19	2040
22	TS	LORNA	24 NOV-28 NOV	5	50	985	360	17	0	582
23	TS	MARIE	19 DEC-21 DEC	3	40	994	150	8	0	480
1969 TOTALS				108				430	184	

*DATA TAKEN FROM BEST TRACK

TABLE 4-3 (Cont'd)

1969 TROPICAL DEPRESSION POSITION DATA

TROPICAL DEPRESSION ELEVEN
07 SEP - 11 SEP

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	070500Z	19.7N	119.2E	20.5N	119.0E	19.7N	112.9E
02	071100Z	18.8N	118.8E	20.3N	117.5E	19.5N	111.3E
03	071700Z	18.2N	119.2E	19.0N	118.0E	18.5N	115.5E
04	072300Z	18.3N	119.6E	18.0N	118.3E	17.4N	117.4E
05	080500Z	18.8N	119.4E	18.5N	119.5E	18.5N	119.5E
06	081100Z	19.2N	119.3E	19.0N	119.0E	18.7N	118.0E
07	081700Z	20.0N	119.6E	19.6N	119.0E	19.1N	117.6E
08	082300Z	20.7N	119.9E	20.2N	120.4E	22.0N	121.3E
09	090500Z	21.5N	120.0E	21.4N	120.1E	23.4N	120.6E
10	091100Z	22.0N	119.9E	22.4N	120.1E	25.9N	121.9E
11	091700Z	22.4N	119.8E	22.8N	120.2E	25.8N	121.7E
12	092300Z	22.8N	119.8E	22.5N	119.5E	-	-
13	100500Z	23.3N	120.3E	23.0N	119.8E	24.5N	120.2E
14	101100Z	23.5N	121.0E	23.9N	121.3E	26.9N	125.3E
15	101700Z	23.2N	121.7E	23.9N	122.5E	27.7N	126.3E
16	102300Z	23.4N	122.4E	24.0N	123.0E	26.3N	126.6E
17	110500Z	23.1N	122.4E	23.5N	122.5E	23.5N	122.5E
18	111100Z	22.6N	122.2E	23.1N	122.4E	23.1N	122.4E

TROPICAL DEPRESSION TWELVE
07 SEP - 08 SEP

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	072300Z	13.5N	111.4E	13.6N	111.4E	13.2N	108.6E
02	080500Z	13.2N	111.0E	13.4N	110.9E	13.0N	108.9E
03	081100Z	12.9N	111.3E	13.3N	110.4E	13.0N	108.3E
04	081700Z	13.1N	112.1E	13.2N	109.9E	12.9N	107.9E
05	082300Z	13.8N	112.8E	14.5N	113.0E	-	-

TROPICAL DEPRESSION THIRTEEN
11 SEP - 12 SEP

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	111100Z	16.3N	130.6E	16.1N	130.8E	19.7N	127.4E
02	111700Z	17.0N	129.5E	16.8N	129.8E	20.9N	127.0E
03	112300Z	17.8N	128.7E	17.8N	129.0E	22.1N	126.8E
04	120500Z	18.8N	128.0E	18.7N	127.6E	22.9N	124.9E

TROPICAL DEPRESSION SEVENTEEN
30 SEP - 01 OCT

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	302300Z	15.4N	118.5E	17.3N	118.0E	19.0N	117.0E
02	010500Z	15.9N	118.1E	16.5N	118.5E	-	-

1969 TROPICAL STORM POSITION DATA

TROPICAL STORM RITA
07 MAR - 09 MAR

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	070500Z	05.3N	168.9E	05.4N	168.6E	06.4N	162.7E
02	071100Z	05.6N	168.2E	05.7N	167.4E	06.4N	161.5E
03	071700Z	05.9N	167.4E	06.0N	165.9E	06.5N	160.0E
04	072300Z	06.2N	166.4E	06.0N	166.0E	06.5N	160.9E
05	080500Z	06.5N	165.4E	06.4N	165.6E	07.0N	161.3E
06	081100Z	06.8N	164.5E	07.1N	164.5E	07.5N	159.5E
07	081700Z	07.1N	163.5E	06.9N	163.0E	07.5N	157.9E
08	082300Z	07.3N	162.5E	07.3N	162.8E	08.0N	158.6E
09	090500Z	07.5N	161.5E	07.5N	161.6E	08.0N	157.0E
10	091100Z	07.7N	160.3E	07.7N	160.4E	08.1N	155.7E
11	091700Z	07.7N	159.1E	07.8N	159.4E	08.1N	154.6E
12	092300Z	07.7N	157.9E	07.8N	157.7E	08.1N	152.8E

TROPICAL STORM WINNIE
29 JUL - 31 JUL

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	292300Z	16.0N	133.4E	16.0N	133.5E	18.8N	129.7E
02	300500Z	17.2N	132.3E	16.6N	132.6E	19.3N	129.2E
03	3001100Z	17.9N	131.1E	18.0N	131.0E	21.2N	127.2E
04	301700Z	18.4N	129.6E	18.9N	129.6E	22.3N	126.2E
05	302300Z	18.7N	128.1E	19.0N	127.9E	22.7N	123.6E
06	310500Z	19.0N	126.8E	19.0N	126.7E	20.1N	123.3E
07	311100Z	19.3N	125.8E	19.0N	126.1E	17.7N	123.5E

TROPICAL STORM ALICE
02 AUG - 04 AUG

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	020500Z	23.7N	137.8E	23.4N	137.6E	25.6N	133.4E
02	021100Z	24.7N	137.0E	24.0N	136.5E	26.0N	132.4E
03	021700Z	25.9N	136.3E	26.7N	135.8E	32.4N	137.5E
04	022300Z	27.0N	135.6E	27.1N	135.5E	30.9N	135.0E
05	030500Z	28.0N	135.2E	28.0N	135.1E	32.1N	134.9E
06	031100Z	29.2N	134.6E	29.0N	134.7E	33.8N	135.5E
07	031700Z	30.3N	134.4E	30.2N	134.3E	34.7N	135.9E
08	032300Z	31.3N	134.5E	31.2N	134.6E	37.0N	137.6E
09	040500Z	32.5N	134.3E	32.5N	134.5E	-	-
10	041100Z	33.6N	135.8E	33.8N	135.8E	-	-

TROPICAL STORM FLOSSIE
29 SEP - 05 OCT
08 OCT - 09 OCT

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	292300Z	15.7N	129.0E	15.7N	128.9E	17.7N	125.3E
02	300500Z	16.8N	127.9E	16.8N	128.0E	20.8N	126.1E
03	301100Z	18.1N	126.8E	18.2N	126.8E	22.5N	125.2E
04	301700Z	18.9N	125.3E	19.1N	125.8E	23.5N	124.8E
05	302300Z	19.8N	123.8E	19.6N	123.4E	20.4N	116.3E
06	010500Z	20.5N	122.9E	21.2N	122.9E	25.0N	122.7E
07	011100Z	20.3N	122.1E	20.5N	122.4E	21.4N	122.1E
08	011700Z	20.8N	121.8E	20.7N	121.6E	21.7N	120.7E
09	012300Z	21.5N	122.0E	21.2N	122.0E	21.2N	122.0E
10	020500Z	22.2N	121.7E	22.1N	121.8E	24.1N	122.3E
11	021100Z	22.8N	121.7E	23.1N	121.8E	25.4N	122.8E
12	021700Z	23.2N	122.1E	23.3N	121.8E	24.8N	122.3E
13	022300Z	23.6N	122.4E	23.6N	122.4E	25.0N	123.3E
14	030500Z	24.1N	122.6E	24.1N	122.6E	25.9N	123.9E
15	031100Z	24.2N	122.8E	24.3N	122.7E	25.5N	123.4E
16	031700Z	24.2N	123.0E	24.0N	122.5E	25.1N	122.8E
17	032300Z	24.3N	123.2E	24.5N	123.2E	25.2N	123.9E
18	040500Z	24.3N	123.4E	24.2N	122.9E	24.2N	122.9E
19	041100Z	24.3N	123.6E	24.2N	123.2E	24.2N	123.2E
20	041700Z	24.3N	123.8E	24.2N	123.3E	24.2N	123.3E
21	042300Z	24.5N	124.2E	24.3N	123.9E	24.3N	124.1E
22	050500Z	24.8N	124.6E	24.8N	124.7E	25.9N	127.7E
23	051100Z	24.8N	125.0E	24.9N	125.1E	25.0N	126.2E
24	051700Z	24.9N	125.4E	24.8N	125.4E	25.0N	126.7E
25	052300Z	25.0N	124.9E	24.8N	125.6E	-	-
26	080500Z	26.8N	131.9E	26.9N	131.4E	28.9N	135.3E
27	081100Z	27.6N	133.5E	27.6N	133.3E	33.1N	139.8E

TROPICAL STORM FLOSSIE (Cont'd)
29 SEP - 05 OCT
08 OCT - 09 OCT

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
28	081700Z	28.9N	135.5E	29.0N	135.4E	36.4N	142.0E
29	082300Z	31.1N	137.8E	30.8N	137.6E	41.0N	143.3E
30	090500Z	34.0N	141.8E	34.7N	140.8E	-	-
31	091100Z	37.3N	146.5E	37.4N	146.3E	-	-
32	091700Z	41.0N	151.0E	41.3N	150.2E	-	-

TROPICAL STORM LORNA
24 NOV - 28 NOV

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	241100Z	09.9N	133.1E	09.8N	132.9E	11.2N	129.1E
02	241700Z	10.4N	132.6E	10.3N	132.6E	11.9N	129.6E
03	242300Z	10.9N	132.1E	10.8N	132.1E	12.8N	129.4E
04	250500Z	11.6N	131.7E	11.5N	131.7E	13.5N	129.7E
05	251100	12.2N	131.3E	12.4N	131.2E	15.4N	130.2E
06	251700Z	12.9N	131.3E	12.6N	131.0E	15.2N	130.2E
07	252300Z	13.5N	131.5E	13.4N	131.5E	16.2N	131.9E
08	260500Z	14.3N	131.6E	14.5N	131.5E	18.2N	132.3E
09	261100Z	13.7N	131.7E	14.2N	131.8E	15.5N	132.7E
10	261700Z	13.5N	131.3E	13.3N	130.7E	14.8N	131.3E
11	262300Z	13.7N	130.9E	13.9N	131.1E	13.9N	131.1E
12	270500Z	14.1N	130.6E	13.9N	130.7E	13.9N	130.7E
13	271100Z	14.4N	130.1E	14.4N	129.5E	16.1N	128.1E
14	271700Z	14.5N	129.6E	15.5N	128.6E	19.8N	128.4E
15	272300Z	14.8N	129.2E	16.4N	128.2E	20.2N	128.6E
16	280500Z	15.3N	128.9E	14.8N	129.5E	16.5N	128.5E
17	281100Z	15.7N	128.6E	16.3N	128.5E	-	-

TROPICAL STORM MARIE
19 DEC - 21 DEC

WARNING NO.	DTG	BEST TRACK POSIT LAT	BEST TRACK POSIT LONG	WARNING POSIT LAT	WARNING POSIT LONG	24 HOUR FORECAST POSIT LAT	24 HOUR FORECAST POSIT LONG
01	191100Z	15.2N	141.7E	15.3N	141.7E	19.2N	140.3E
02	191700Z	16.2N	141.4E	16.3N	141.1E	20.3N	140.9E
03	192300Z	17.1N	141.2E	17.1N	141.3E	19.9N	141.3E
04	200500Z	17.9N	141.3E	18.5N	141.0E	22.7N	143.7E
05	201100Z	17.8N	142.3E	17.8N	141.6E	20.1N	142.7E
06	201700Z	18.3N	143.6E	18.3N	143.3E	21.2N	146.7E
07	202300Z	18.9N	145.1E	19.0N	145.2E	-	-
08	210500Z	18.0N	144.4E	17.8N	143.0E	-	-

Forecast positions for the 24, 48 and 72 hour forecasts are verified only as long as the best track analysis estimates winds in excess of 33 knots for tropical cyclones which reach typhoon intensity.

In addition to this method of verifying absolute error distance, a computation of closest distance to the best track (right angle error) has been included to indicate the demonstrated ability to forecast the path of motion without regard to speed.

The following tables and figures are presented to graphically depict the distribution of forecasting error in JTWC forecasts.

FORECAST VERIFICATION
AVERAGE ERROR (NAUTICAL MILES)

	24 HR	48 HR	72 HR
1950-58	170	---	---
1959	*117	*267	---
1960	177	354	---
1961	136	274	---
1962	144	287	476
1963	127	246	374
1964	133	284	429
1965	151	303	418
1966	136	280	432
1967	125	276	414
1968	105	229	337
1969	111	237	349

*FORECAST POSITIONS NORTH OF 35N WERE NOT VERIFIED.

TABLE 4-4

JTWC OFFICIAL FORECAST ACCURACY

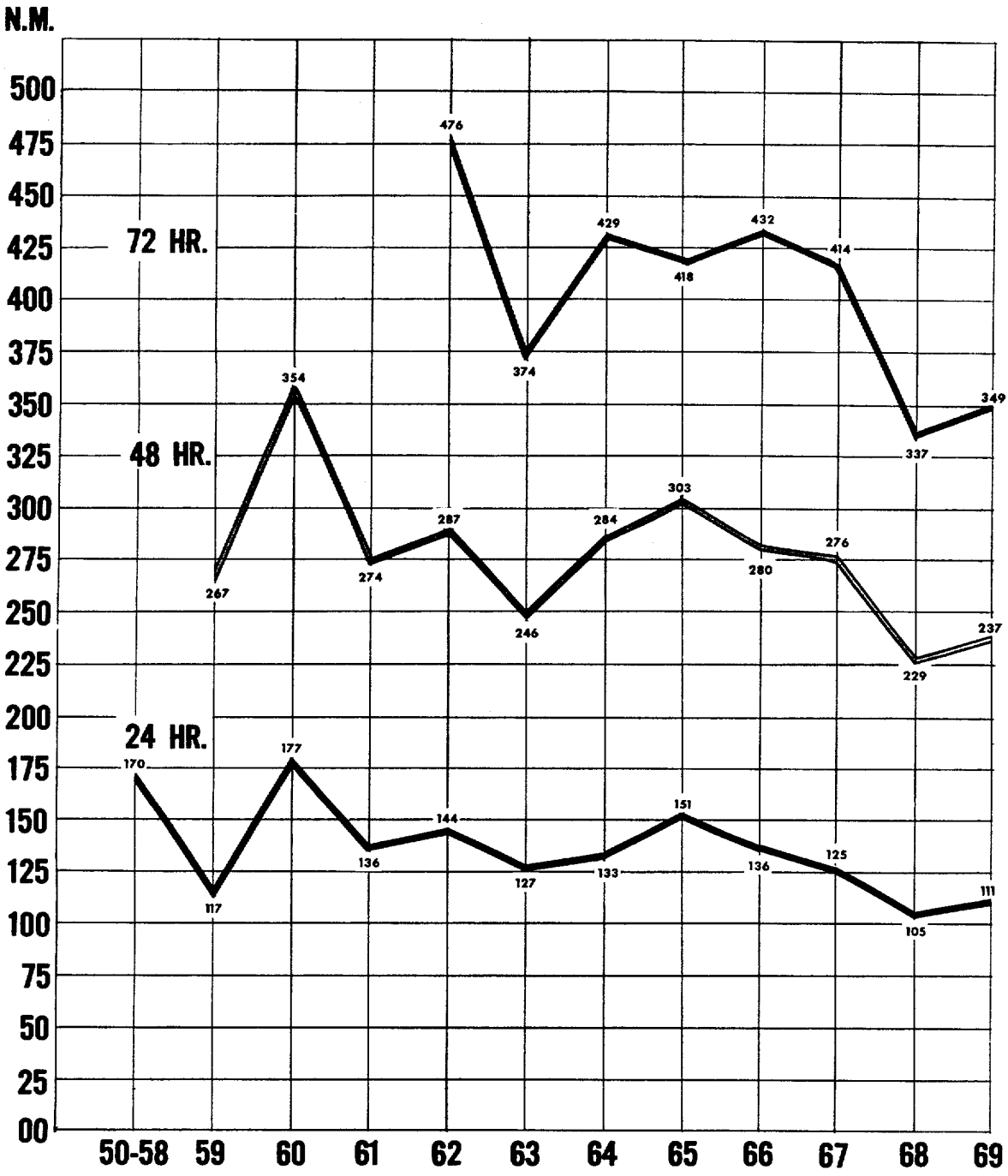


FIG 4-1

FORECAST ERROR TABULATION - 1969

	CASES	MEAN ERROR (N.M.)
24 Hour		
Whole Sample	248	111
Below 20N	132	103
20N - 30N	96	117
Below 30N	228	109
Above 30N	20	134
48 Hour		
Whole Sample	166	237
Below 20N	63	202
20N - 30N	82	240
Below 30N	145	224
Above 30N	21	330
72 Hour		
Whole Sample	57	349
Below 20N	16	305
20N - 30N	31	346
Below 30N	47	332
Above 30N	10	429

TABLE 4-5

DISTANCE BETWEEN OPERATIONAL WARNING
POSITIONS AND BEST TRACK POSITIONS

	CYCLONE	NUMBER OF WARNINGS	AVERAGE DISTANCE (NM)	MAXIMUM DISTANCE (NM)	MINIMUM DISTANCE (NM)
1.	T. PHYLLIS	24	16	45	01
2.	T.S. RITA	12	26	87	08
3.	T. SUSAN	29	14	39	03
4.	T. TESS	13	29	150	00
5.	T. VIOLA	26	16	42	02
6.	T.S. WINNIE	07	20	37	08
7.	T.S. ALICE	10	19	55	06
8.	T. BETTY	14	15	45	05
9.	T. CORA	34	14	52	05
10.	T. DORIS	09	11	19	03
11.	T.D.	18	42	118	06
12.	T.D.	05	50	128	05
13.	T.D.	04	20	27	17
14.	T. ELSIE	34	17	61	04
15.	T.S. FLOSSIE	32	19	60	04
16.	T. GRACE	29	35	128	03
17.	T.D.	02	82	118	45
18.	T. HELEN	20	20	88	05
19.	T. IDA	26	15	59	03
20.	T. JUNE	33	17	71	03
21.	T. KATHY	24	19	80	04
22.	T.S. LORNA	17	29	104	06
23.	T.S. MARIE	08	28	82	05
1969	SEASON	430	20.7	150	00

TABLE 4-6

1969 AVERAGE FORECAST ERRORS (MI)*

TYPHOON	24 HR FORECASTS CASES	24 HR FORECASTS ERROR	48 HR FORECASTS CASES	48 HR FORECASTS ERROR	72 HR FORECASTS CASES	72 HR FORECASTS ERROR
PHYLLIS	16	91	12	140	04	220
SUSAN	21	61	13	110	04	184
TESS	08	168	01	360	-	-
VIOLA	22	99	16	181	06	167
BETTY	10	107	06	243	01	330
CORA	29	77	22	203	08	405
DORIS	05	63	01	48	-	-
ELSIE	29	92	22	176	09	316
GRACE	25	186	17	429	05	715
HELEN	14	123	08	438	02	420
IDA	22	87	16	176	06	288
JUNE	27	139	18	267	07	319
KATHY	20	145	14	338	05	498
TOTAL CASES	248		166		57	
MEAN ERROR		111		237		349

* INCLUDES FORECAST ERRORS DURING TROPICAL STORM INTENSITY.

TABLE 4-7

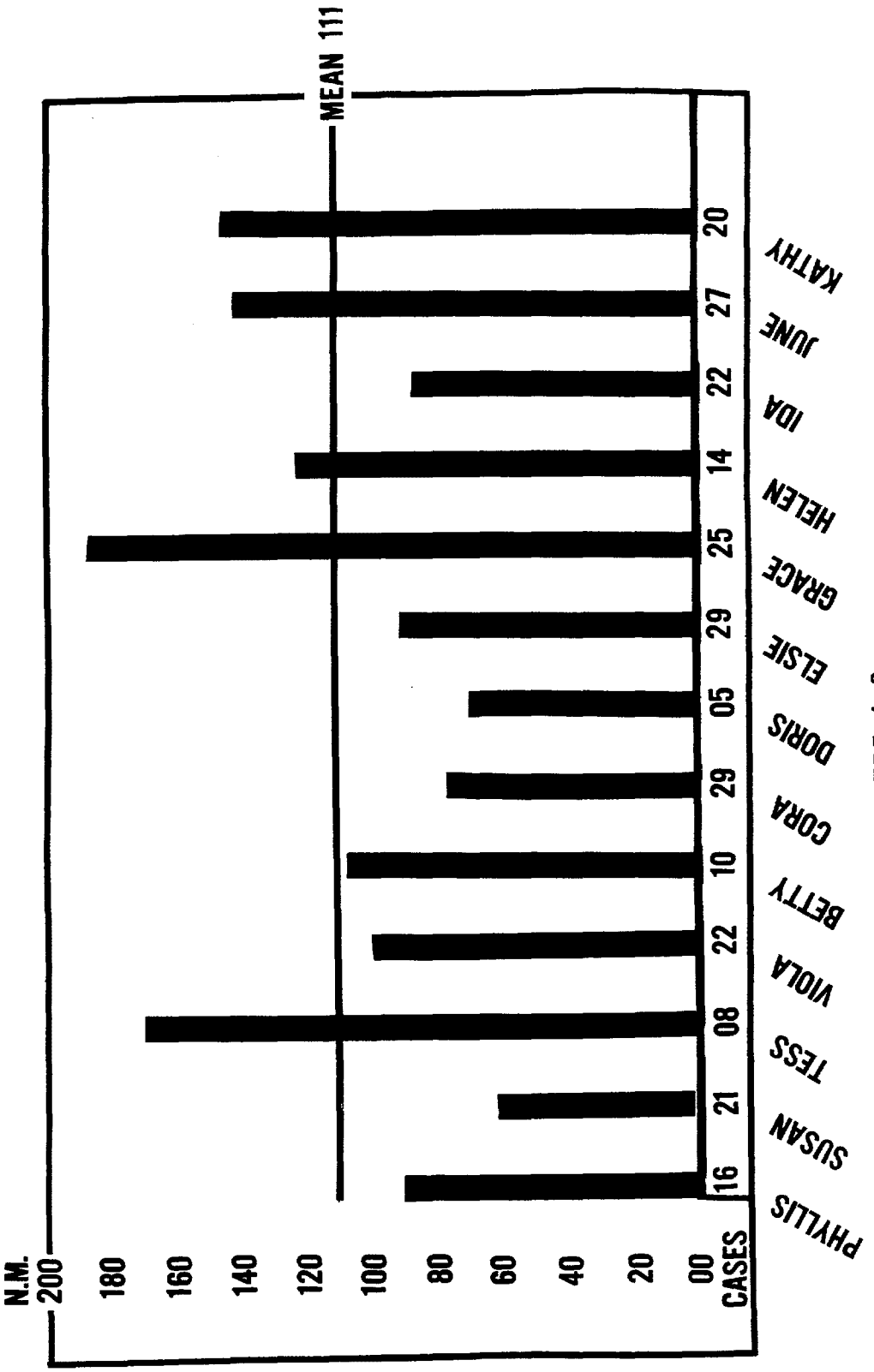

INDIVIDUAL TYPHOONS OF 1969
24 HOUR VERIFICATION ERROR
N.M.
200
180
160
140
120
100
80
60
40
20
00
CASES
MEAN 111
16
21
08
22
10
29
05
29
25
14
22
27
20
PHYLLIS
SUSAN
TESS
VIOLA
BETTY
CORA
DORIS
ELSIE
GRACE
HELEN
IDA
JUNE
KATHY

FIG 4-2

1969 RIGHT ANGLE FORECAST ERRORS
(CLOSEST DISTANCE (N.M.) TO BEST TRACK)

TYPHOON	24 HR FORECASTS CASES	24 HR FORECASTS ERROR	48 HR FORECASTS CASES	48 HR FORECASTS ERROR	72 HR FORECASTS CASES	72 HR FORECASTS ERROR
PHYLLIS	16	52	12	88	04	129
SUSAN	21	46	13	91	04	178
TESS	08	94	01	268	-	-
VIOLA	22	63	16	109	06	111
BETTY	10	45	06	97	01	33
CORA	29	58	22	180	08	349
DORIS	05	54	01	48	-	-
ELSIE	29	46	22	102	09	151
GRACE	25	117	17	188	05	265
HELEN	14	54	08	18	02	65
IDA	22	72	16	132	06	200
JUNE	27	58	18	123	07	173
KATHY	20	79	14	209	05	409
TOTAL CASES	248		166		57	
MEAN ERROR		65		130		209

* INCLUDES FORECAST ERRORS DURING TROPICAL STORM INTENSITY.

TABLE 4-8

RIGHT ANGLE ERROR

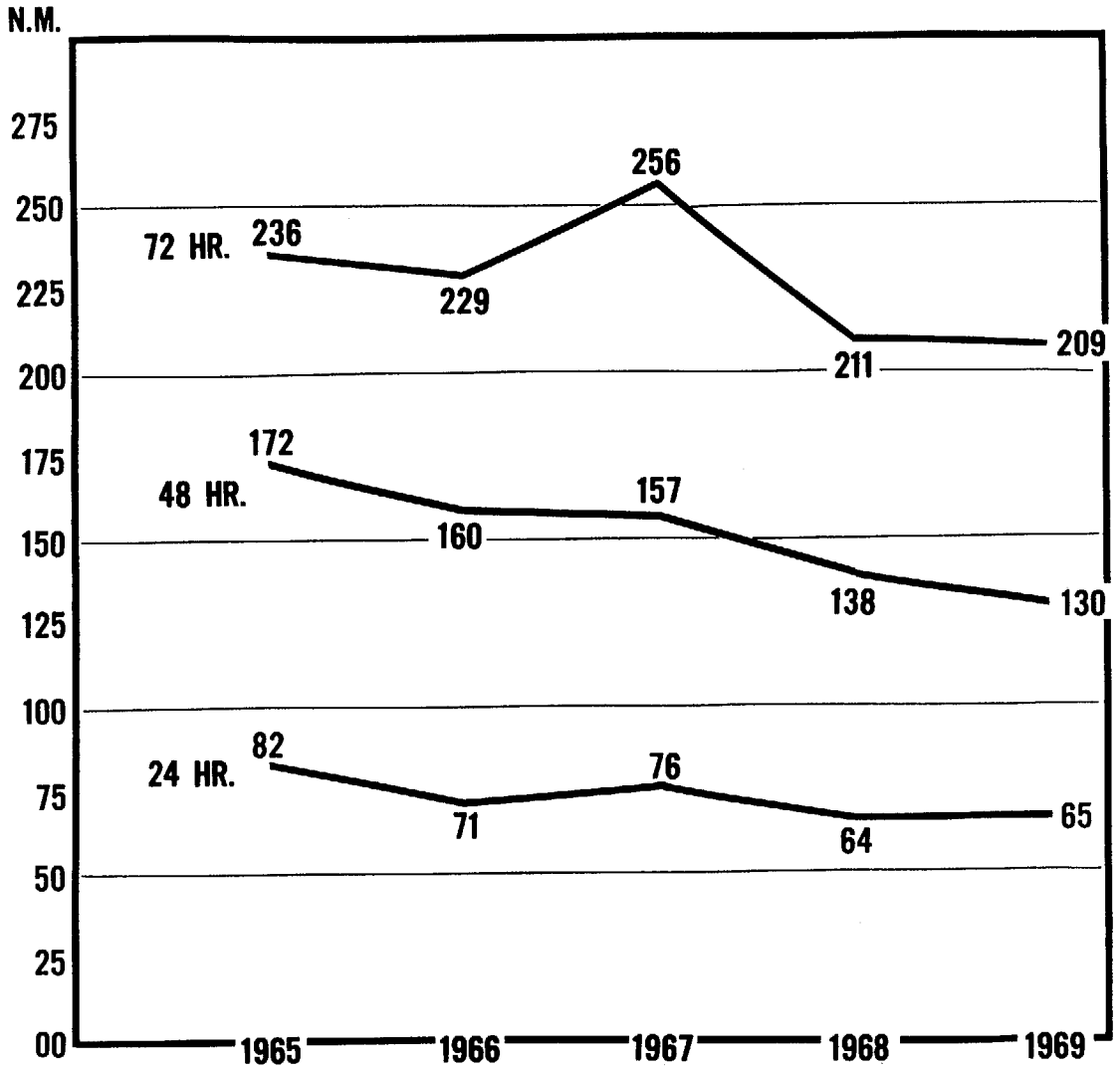


FIG 4-3

CHAPTER V

INDIVIDUAL TYPHOONS OF 1969

NOTE. See Appendix A for definitions or clarification of words or phrases that appear in this chapter.

TYPHOON PHYLLIS - 01/17/0500Z TO 01/22/2300Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 24
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 15
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1968 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 966 MBS AT 182100Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2819 M AT 182100Z
3. MAXIMUM SURFACE WIND - 085 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 240 MI

II. DEVELOPMENT

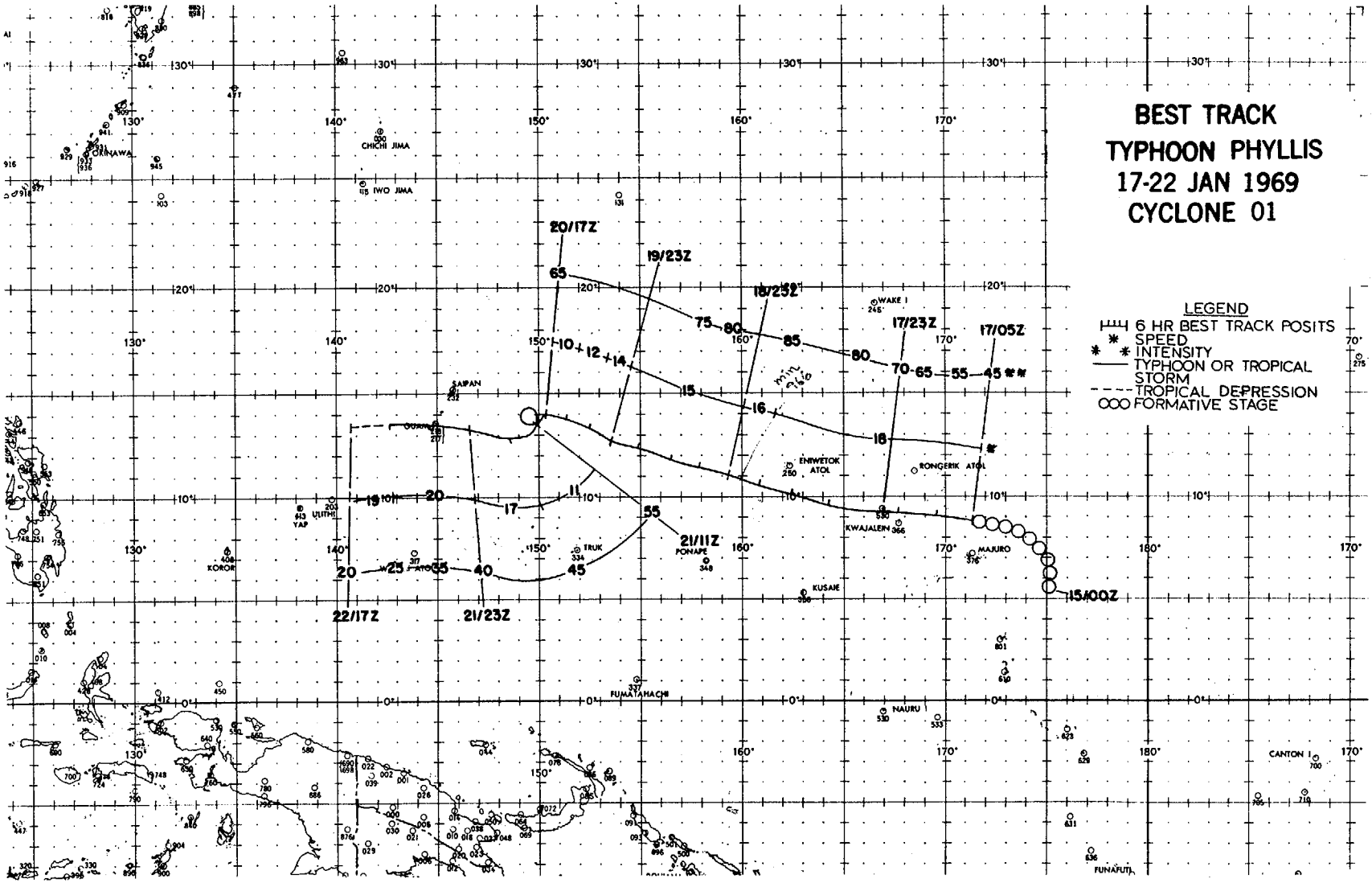
A. INITIAL IMPETUS - LOW LEVEL SURGE INTO CYCLONIC CIRCULATION FROM THE SOUTH WITH SUBSEQUENT DIVERGENCE AT 200 MB LEVEL.

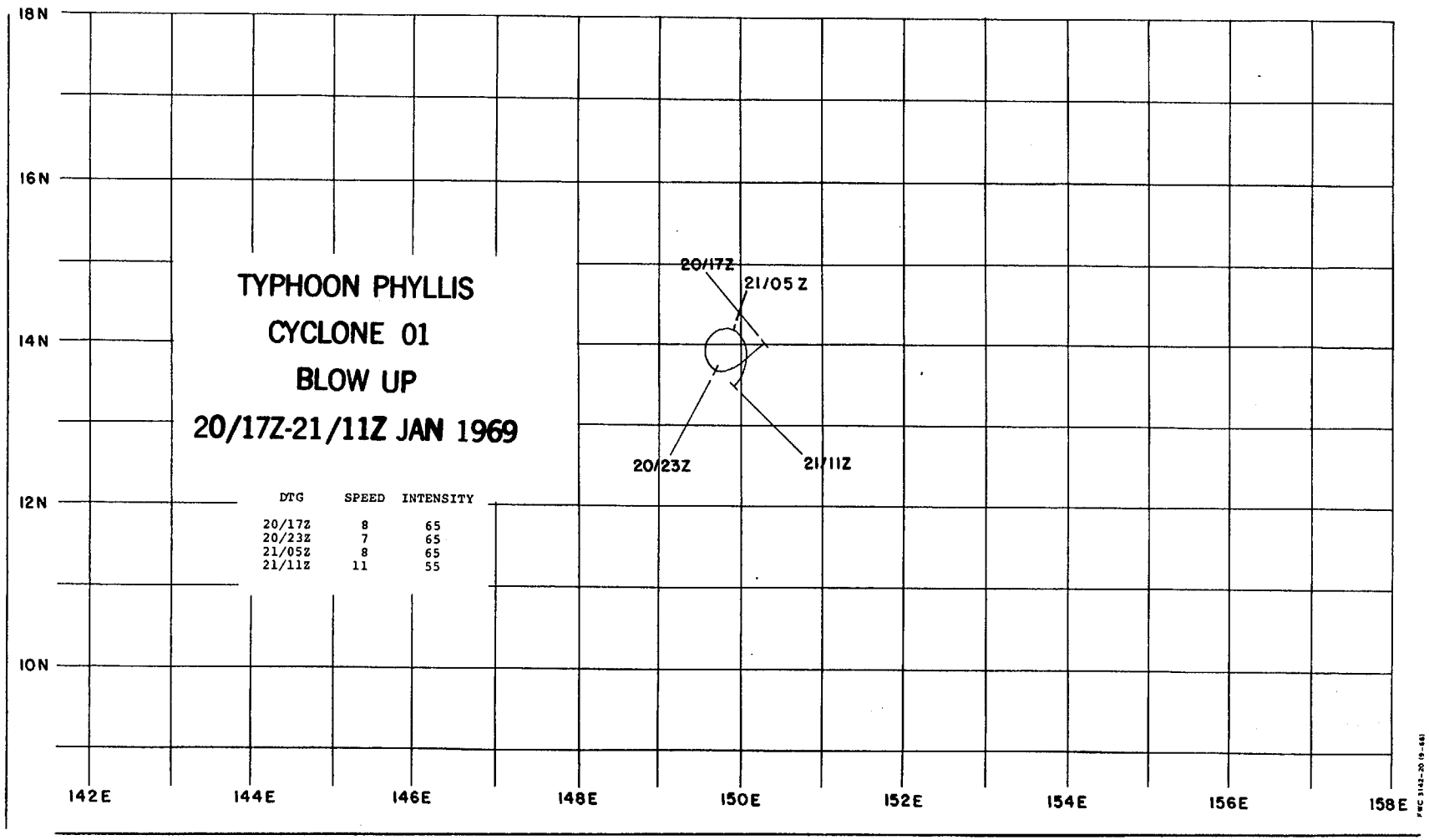
B. INITIAL SURFACE VORTEX
1. EMBEDDED VORTEX AT 140000Z
2. SURFACE PRESSURE LESS THAN 1006 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - SOUTHEAST
2. UPON REACHING TYPHOON INTENSITY - SOUTHEAST

III. FINAL DISPOSITION

A. DISSIPATED OVER WATER


BEST TRACK
TYPHOON PHYLLIS
17-22 JAN 1969
CYCLONE 01
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
20/17Z
19/23Z
18/23Z
17/23Z
17/05Z
15/00Z
21/11Z
21/23Z
22/17Z
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
YAP
ULITHI
KOROR
TRUK
PONAPE
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
KUSAIE
FUMATAHACHI
NAURU
CANTON I
FUNAFUTI


18N
16N
14N
12N
10N
142E
144E
146E
148E
150E
152E
154E
156E
158E
TYPHOON PHYLLIS
CYCLONE 01
BLOW UP
20/17Z-21/11Z JAN 1969
DTG SPEED INTENSITY
20/17Z 8 65
20/23Z 7 65
21/05Z 8 65
21/11Z 11 55
20/17Z
21/05 Z
20/23Z
21/11Z

EYE FIXES CYCLONE 01

FIX NO.	TIME	POSITION	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL TT/TD	EYE FORM	ORIEN-TATION	EYE DIA	TURNS WALL CLOUD
1	160314Z	08.0N 176.0E	SLTLS	STG X	DIA 02	BNDS 3							
2	170409Z	09.0N 170.5E	SLTLS	STG X	DIA 03	BNDS 3		918					
3	170605Z	08.7N 171.1E	54-P-03-05	700MB	080	055	980	2899	17/12	----			--
4	170900Z	09.1N 170.0E	LND RDR		---	---	---	---	--/--	----			--
5	171200Z	09.0N 168.8E	LND RDR		---	---	---	---	--/--	CIRC	----	25	--
6	171400Z	09.0N 168.5E	LND RDR		---	---	---	---	--/--	CIRC	----	25	--
7	171503Z	09.0N 168.2E	LND RDR		---	---	---	---	--/--	CIRC	----	24	--
8	171600Z	09.2N 167.9E	LND RDR		---	---	---	---	--/--	CIRC	----	26	--
9	171652Z	09.1N 167.8E	LND RDR		---	---	---	98 ---	--/--	----			--
10	172100Z	09.1N 166.6E	54-P-01-03	700MB	080	080	977	2920	17/08	CIRC	----	20	--
11	180015Z	09.5N 165.6E	LND RDR		---	---	---	---	--/--	CIRC	----	42	--
12	180120Z	09.2N 165.2E	LND RDR		---	---	---	---	--/--	----			--
13	180142Z	09.3N 165.1E	54-P------		---	---	---	2850	10/--	----			--
14	180215Z	09.2N 165.2E	LND RDR		---	---	---	---	--/--	CIRC	----	36	--
15	180250Z	09.3N 164.9E	54-P-05-03	700MB	080	090	972	2850	10/10	CIRC	----	25	--
16	180309Z	10.0N 163.0E	SLTLS	STG X	DIA 06	BNDS 3							
17	180900Z	10.0N 162.9E	VW-R----20		---	---	---	---	--/--	----			--
18	180930Z	10.0N 162.8E	VW-R-10-10		---	---	---	---	--/--	CIRC	----	25	--
19	181100Z	09.4N 162.3E	LND RDR		---	---	---	---	--/--	CIRC	----	40	--
20	181155Z	09.9N 162.1E	LND RDR		---	---	---	---	--/--	CIRC	----	40	--
21	181255Z	10.0N 161.4E	LND RDR		---	---	---	---	--/--	CIRC	----	44	--
22	181455Z	10.8N 160.7E	LND RDR		---	---	---	---	--/--	CIRC	----	55	--
23	181545Z	10.7N 160.9E	VW-R-05-10		---	---	---	---	--/--	CIRC	----	30	--
24	182100Z	11.0N 159.7E	54-P-03-03	700MB	090	085	966	2819	12/12	CIRC	----	20	--
25	190230Z	11.3N 158.5E	54-P-05-03	700MB	090	080	973	2868	18/12	CIRC	----	20	--
26	190404Z	11.5N 157.5E	SLTLS	STG X	DIA 03	BNDS 4							
27	190905Z	11.6N 157.3E	VW-P-05-05	0450M	---	065	968	---	16/22	CIRC	----	20	--
28	191415Z	12.1N 155.7E	VW-R-05-10		---	---	---	---	--/--	ELIP	N-S	25X20	--
29	192100Z	12.6N 154.0E	54-P-03-05	700MB	070	075	971	2880	10/12	CIRC	----	13	--
30	200300Z	13.1N 152.5E	54-P-05-06	700MB	---	080	976	2883	11/10	CIRC	----	14	10
31	200459Z	13.0N 152.0E	SLTLS	STG X	DIA 03	BNDS 4							
32	200848Z	13.5N 152.0E	VW-R-10-05		---	---	---	---	--/--	CIRC	----	30	--
33	201158Z	13.8N 151.2E	VW-P-10-05	700MB	---	---	---	2903	14/09	CIRC	----	15	--
34	201501Z	14.2N 150.5E	VW-P-10-03	700MB	---	---	---	2870	15/15	ELIP	NW-SE	14X09	--
35	202000Z	13.7N 150.3E	54-R------		---	---	---	---	--/--	----			--
36	202115Z	13.7N 150.0E	54-P-05-03	700MB	080	085	977	2938	20/12	CIRC	----	20	--
37	210000Z	13.8N 149.8E	54-P-05-03	700MB	085	085	980	2951	20/12	CIRC	----	20	--
38	210310Z	13.7N 149.6E	54-P-05-03	700MB	085	070	975	2920	18/12	CIRC	----	20	--
39	210359Z	13.5N 149.5E	SLTLS	STG X	DIA 02	BNDS 3							
40	210900Z	14.2N 149.8E	VW-R-03-05		---	---	---	---	--/--	CIRC	----	20	10
41	211226Z	13.7N 150.0E	VW-R-10-03		---	---	---	---	--/--	CIRC	----	22	--
42	211515Z	13.1N 149.6E	VW-P-05-02	0450M	---	055	987	3063	27/24	CIRC	----	20	--
43	211805Z	12.8N 148.5E	VW-R-10-05		---	---	---	---	--/--	CIRC	----	20	--
44	212100Z	13.2N 147.1E	54-P-02-03	700MB	030	040	997	3075	16/11	----			--
45	212245Z	13.4N 146.5E	LND RDR		---	---	---	---	--/--	----			--
46	212350Z	13.5N 146.2E	LND RDR		---	---	---	---	--/--	----			--
47	220100Z	13.5N 145.8E	LND RDR		---	---	---	---	--/--	----			--
48	220130Z	13.5N 145.7E	LND RDR		---	---	---	---	--/--	----			--

EYE FIXES CYCLONE 01

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL T/TD	EYE FORM	ORIEN-TATION	EYE DIA	TRANS WALL CLOUD
49	220200Z	13.5N 145.5E	LND RDR		---	---	---	---	--/--	----			--
50	220230Z	13.5N 145.3E	LND RDR		---	---	---	---	--/--	----			--
51	220300Z	13.7N 145.3E	LND RDR		---	---	---	---	--/--	----			--
52	220315Z	13.5N 145.3E	54-P-02-10	0450M	023	020	995	---	25/25	----			F.B.
53	220330Z	13.5N 145.0E	LND RDR		---	---	---	---	--/--	----			--
54	220430Z	13.5N 144.7E	LND RDR		---	---	---	---	--/--	----			--
55	220454Z	13.0N 144.5E	SLTLS	STG C	DIA --	BNDS -							
56	220530Z	13.5N 144.5E	LND RDR		---	---	---	---	--/--	----			--
57	220725Z	13.4N 144.0E	LND RDR		---	---	---	---	--/--	----			--
58	220905Z	13.6N 143.4E	VW-P-03-05	0450M	033	030	998	---	26/24	----			F.B.
59	220920Z	13.4N 143.6E	LND RDR		---	---	---	---	--/--	----			--
60	221447Z	13.6N 141.2E	VW-P-05-05	0450M	030	035	001	---	25/23	----			--
61	222130Z	13.0N 139.8E	54-P-03-15	0470M	020	015	---	---	--/--	----			--

TYPHOON PHYLLIS

TROPICAL CYCLONE 01 -- 01/17/1100Z TO 01/22/1700Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
01	170500Z	08.7N	171.0E	08.9N	171.3E	09.5N	165.4E	--------	10.1N	160.4E	--------	10.8N	156.0E	--------
02	171100Z	08.9N	169.8E	09.1N	169.5E	09.7N	163.8E	--------	10.5N	157.9E	--------	-	-	--------
03	171700Z	09.2N	167.7E	09.2N	167.7E	10.0N	161.4E	--------	10.5N	155.4E	--------	11.5N	149.6E	--------
04	172300Z	09.3N	166.0E	09.3N	165.9E	09.7N	159.8E	--------	10.0N	154.2E	--------	-	-	--------
05	180500Z	09.5N	164.3E	09.7N	164.1E	10.2N	157.6E	--------	10.7N	151.5E	--------	11.6N	146.4E	--------
06	181100Z	09.7N	162.5E	10.1N	162.4E	10.3N	155.7E	107-0078	10.9N	149.7E	--------	-	-	--------
07	181700Z	10.7N	160.5E	10.7N	160.8E	12.8N	154.1E	144-0048	15.0N	149.4E	--------	18.0N	145.0E	--------
08	182300Z	11.1N	159.2E	11.1N	159.3E	13.0N	153.8E	164-0084	14.6N	150.2E	--------	-	-	--------
09	190500Z	11.5N	158.0E	11.5N	157.9E	12.9N	152.9E	189-0078	14.2N	148.3E	--------	15.3N	144.7E	--------
10	191100Z	11.8N	156.9E	11.9N	156.4E	13.1N	152.1E	201-0102	14.4N	147.9E	134-0114	-	-	--------
11	191700Z	12.3N	155.2E	12.4N	154.9E	13.6N	150.5E	299-0048	14.9N	146.2E	168-0114	16.2N	142.0E	--------
12	192300Z	12.8N	153.6E	12.8N	153.6E	14.5N	147.8E	046-0012	15.8N	143.0E	169-0168	-	-	--------
13	200500Z	13.4N	152.0E	13.3N	152.4E	14.9N	147.0E	134-0030	14.6N	142.4E	198-0162	14.2N	137.7E	--------
14	201100Z	13.6N	151.4E	13.8N	151.3E	14.8N	147.5E	134-0054	14.8N	144.2E	208-0192	-	-	--------
15	201700Z	14.1N	150.0E	14.0N	150.3E	14.9N	146.0E	153-0024	14.7N	142.7E	321-0072	14.3N	139.5E	194-0150
16	202300Z	13.8N	149.8E	13.7N	149.7E	14.9N	146.2E	293-0114	15.3N	142.4E	024-0054	-	-	--------
17	210500Z	13.8N	149.4E	14.2N	149.9E	14.3N	147.7E	284-0168	14.5N	145.9E	270-0090	14.4N	144.2E	233-0252
18	211100Z	14.2N	149.8E	13.5N	149.9E	14.2N	149.8E	300-0150	14.5N	148.5E	295-0126	-	-	--------
19	211700Z	12.9N	148.9E	12.8N	148.7E	12.3N	142.5E	308-0198	12.0N	137.0E	311-0186	12.0N	132.0E	326-0372
20	212300Z	13.4N	146.4E	13.3N	146.7E	13.5N	140.5E	345-0096	12.9N	135.4E	305-0258	-	-	--------

AVERAGE 24 HOUR ERROR - 0091 MI.
AVERAGE 48 HOUR ERROR - 0140 MI.
AVERAGE 72 HOUR ERROR - 0220 MI.

TYPHOON SUSAN - 04/18/0500Z TO 04/25/0500Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 29
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 12
3. DISTANCE TRAVELED DURING WARNING PERIOD - 882 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 943 MBS AT 212130Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2615 M AT 222130Z
3. MAXIMUM SURFACE WIND - 105 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 240 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

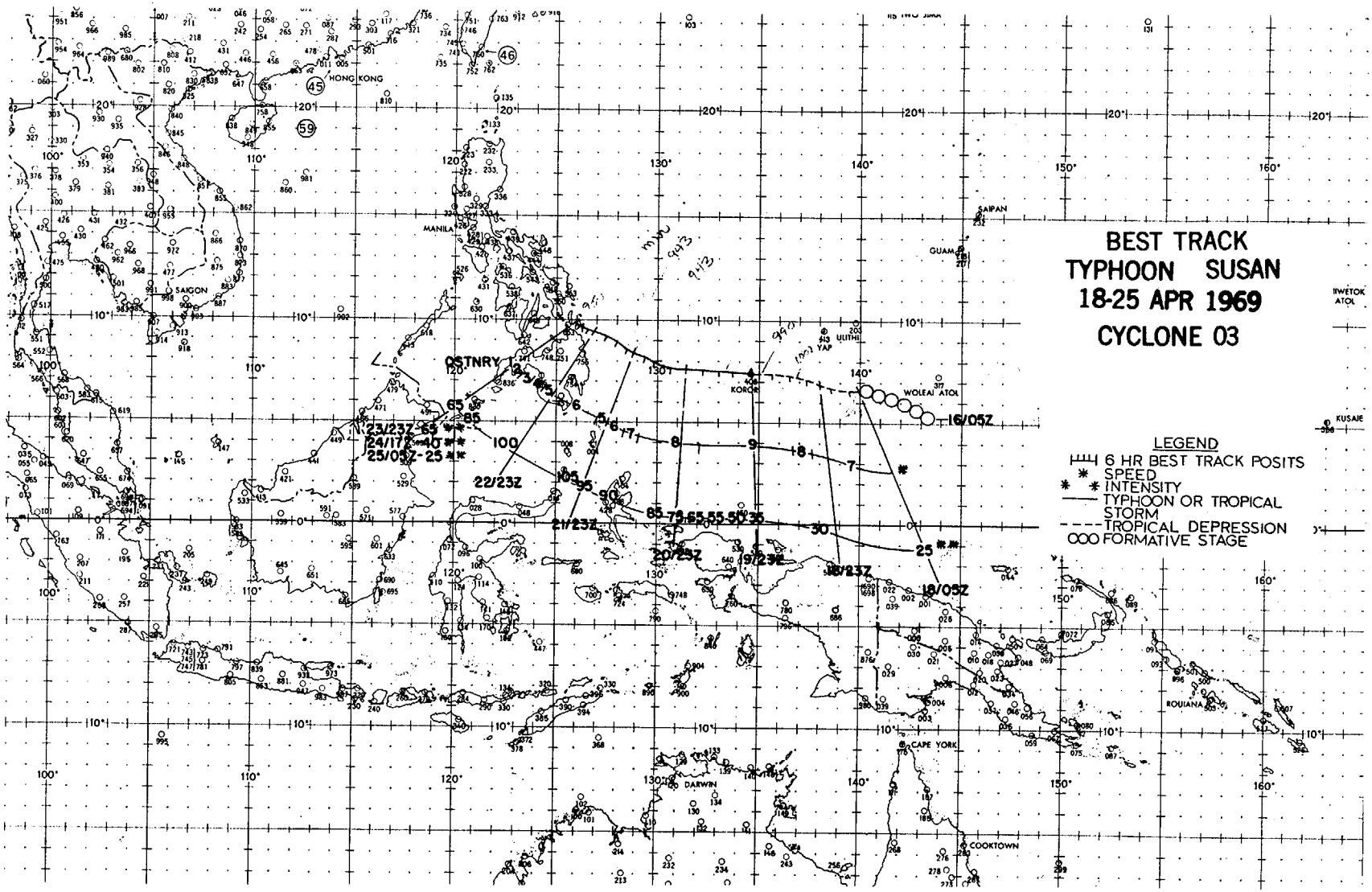
B. INITIAL SURFACE VORTEX

1. EMBEDDED VORTEX AT 160500Z
2. SURFACE PRESSURE LESS THAN 1007 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - SOUTHEAST
2. UPON REACHING TYPHOON INTENSITY - SOUTH

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND


BEST TRACK
TYPHOON SUSAN
18-25 APR 1969
CYCLONE 03
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
HONG KONG
MANILA
SAIGON
DARWIN
GUAM
SAIPAN
YAP
ULITHI
WOLEAI ATOL
IRWETOK ATOL
KUSAIE
ROUIANA
CAPE YORK
COOKTOWN
OSTNRY
16/05Z
18/05Z
22/23Z
21/23Z
20/23Z
19/23Z
18/23Z

EYE FIXES CYCLONE 03

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL T/TD	EYE FORM	ORIEN-TATION	EYE DIA	THKNS WALL CLOUD
1	160508Z	07.0N 143.0E	SLTLS	STG C	DIA --	BNDS -							
2	170411Z	06.0N 143.0E	SLTLS	STG C	DIA --	BNDS -							
3	180510Z	09.0N 140.0E	SLTLS	STG B	DIA --	BNDS -							
4	180530Z	06.4N 139.9E	54-P-03-02	035M	033	025	999	---	21/25	----			--
5	182130Z	07.1N 138.2E	54-P-10-10	700MB	038	028	000	3072	11/10	----			--
6	190255Z	06.9N 137.4E	54-P-10-05	046OM	030	030	000	---	21/25	----			--
7	190417Z	08.0N 137.0E	SLTLS	STG B	DIA --	BNDS -							
8	190725Z	06.0N 137.6E	VW-R----15		---	---	---	---	--/--	----			--
9	190905Z	07.3N 136.8E	VW-P-05-10	032OM	---	030	002	---	27/24	----			--
10	192100Z	07.3N 134.9E	54-P-05-04	700MB	048	035	990	3027	17/12	CIRC	----	12	--
11	200230Z	07.4N 134.0E	54-P-05-04	700MB	041	050	988	3008	16/12	CIRC	----	15	--
12	200512Z	07.5N 133.0E	SLTLS	STG B	DIA --	BNDS -							
13	200740Z	07.3N 133.1E	VW-R----15		---	---	---	---	--/--	----			--
14	200845Z	07.5N 133.1E	VW-P-05-03	045OM	072	055	978	---	25/22	CIRC	----	23	--
15	201400Z	07.7N 132.3E	VW-R-05-10		---	---	---	---	--/--	CIRC	----	15	--
16	202045Z	07.8N 131.5E	54-P-03-03	700MB	085	065	963	2768	18/11	CIRC	----	18	05
17	210230Z	07.8N 130.9E	54-P-25-01	700MB	083	080	950	2652	21/10	CIRC	----	10	05
18	210611Z	08.0N 130.5E	SLTLS	STG X	DIA 03	BNDS 3							
19	211400Z	08.0N 129.4E	VW-R-20-02		---	---	---	---	--/--	----			05
20	212130Z	08.2N 129.0E	54-P-03-02	700MB	095	085	943	2618	20/17	CIRC	----	10	--
21	220205Z	08.4N 128.8E	54-P-10-01	700MB	085	100	943	2618	24/18	CIRC	----	09	--
22	220518Z	08.5N 128.0E	SLTLS	STG X	DIA 03	BNDS 4							
23	220925Z	09.0N 128.2E	VW-R-05-05		---	---	---	---	--/--	CIRC	----	09	--
24	221200Z	09.2N 128.2E	VW-R----05		---	---	---	---	--/--	----			--
25	221450Z	09.4N 127.4E	VW-R-05-05		---	---	---	---	--/--	CIRC	----	12	--
26	222130Z	09.5N 127.0E	54-P-03-03	700MB	095	---	944	2615	18/12	CIRC	----	08	--
27	230315Z	10.1N 126.2E	54-P-05-02	700MB	095	085	950	2652	18/10	CIRC	----	10	--
28	230613Z	10.0N 126.0E	SLTLS	STG X	DIA 03	BNDS 4							
29	230827Z	09.7N 126.1E	VW-R-03-01		---	---	---	---	--/--	CIRC	----	06	03
30	231530Z	09.8N 126.1E	VW-R-05-05		---	---	---	---	--/--	CIRC	----	22	--
31	232100Z	10.0N 126.0E	54-P-01-03	500MB	055	---	---	---	02/55	CIRC	----	20	--
32	240200Z	10.0N 125.8E	54-P-02-05	500MB	050	---	---	---	07/51	----			--
33	240520Z	10.0N 125.5E	SLTLS	STG X	DIA 03	BNDS 2							
34	240842Z	10.0N 126.1E	VW-R----15		---	---	---	---	--/--	----			--
35	240905Z	10.0N 126.0E	VW-R-05-05		---	---	---	---	--/--	CIRC	----	10	N.F.B.
36	241400Z	09.9N 125.8E	VW-R-03-03		---	---	---	---	--/--	CIRC	----	10	N.F.B.

TYPHOON SUSAN

TROPICAL CYCLONE 03 -- 04/18/0500Z TO 04/25/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
08	192300Z	07.4N	134.6E	07.4N	134.7E	08.3N	131.6E	030-0048	09.4N	128.6E	--------	-	-	--------
09	200500Z	07.5N	133.6E	07.5N	133.8E	08.4N	130.3E	060-0030	09.2N	127.1E	--------	10.3N	124.0E	--------
10	201100Z	07.6N	132.8E	07.5N	133.0E	08.6N	129.3E	055-0048	10.0N	126.7E	--------	-	-	--------
11	201700Z	07.8N	131.9E	07.6N	132.2E	08.9N	128.6E	064-0066	10.3N	126.2E	--------	11.8N	124.4E	--------
12	202300Z	07.9N	131.2E	07.7N	131.4E	08.8N	128.3E	019-0036	10.4N	126.1E	--------	-	-	--------
13	210500Z	07.9N	130.4E	07.8N	130.6E	08.8N	127.8E	341-0036	09.5N	125.6E	--------	09.5N	123.6E	--------
14	211100Z	08.1N	129.8E	08.0N	129.9E	09.0N	127.1E	320-0042	09.7N	124.9E	--------	-	-	--------
15	211700Z	08.0N	129.0E	08.2N	129.4E	08.6N	126.3E	314-0054	09.0N	123.7E	--------	08.5N	121.0E	--------
16	212300Z	08.3N	128.8E	08.4N	128.9E	09.0N	126.5E	308-0036	09.3N	124.6E	348-0060	-	-	--------
17	220500Z	08.4N	128.6E	08.7N	128.5E	08.7N	127.8E	279-0036	08.9N	125.6E	291-0078	08.9N	123.6E	--------
18	221100Z	09.1N	128.1E	09.0N	128.0E	10.3N	126.0E	270-0048	10.8N	123.7E	309-0090	-	-	--------
19	221700Z	09.5N	127.2E	09.3N	127.5E	09.5N	124.2E	238-0078	08.7N	121.3E	309-0090	08.2N	118.3E	--------
20	222300Z	09.5N	126.8E	09.5N	126.9E	09.6N	124.4E	211-0030	08.8N	122.2E	322-0066	-	-	--------
21	230500Z	10.2N	126.1E	09.6N	126.5E	12.2N	124.4E	114-0126	14.3N	123.6E	263-0048	17.3N	124.3E	286-0150
22	231100Z	09.9N	126.0E	09.8N	126.2E	10.6N	125.0E	348-0030	12.0N	124.0E	266-0072	-	-	--------
23	231700Z	09.9N	126.0E	09.8N	126.1E	10.5N	125.1E	261-0108	11.8N	124.1E	251-0144	13.2N	123.4E	321-0150
24	232300Z	10.0N	126.0E	09.9N	126.0E	10.8N	125.3E	259-0090	-	-	246-0084	-	-	--------
25	240500Z	10.0N	125.8E	09.9N	126.0E	-	-	326-0162	-	-	197-0060	-	-	261-0138
26	241100Z	10.0N	126.0E	09.9N	126.0E	10.0N	126.0E	307-0066	-	-	292-0138	-	-	--------
27	241700Z	09.9N	125.7E	09.9N	126.0E	09.7N	124.8E	306-0060	-	-	256-0282	-	-	255-0300
28	242300Z	09.8N	125.5E	09.9N	126.0E	-	-	326-0060	-	-	254-0228	-	-	--------

AVERAGE 24 HOUR ERROR - 0061 MI.
AVERAGE 48 HOUR ERROR - 0110 MI.
AVERAGE 72 HOUR ERROR - 0184 MI.

TYPHOON TESS - 07/08/1100Z TO 07/11/1100Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 13
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 03
3. DISTANCE TRAVELED DURING WARNING PERIOD - 906

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 974 MBS AT 100840Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2859 M AT 100215Z
3. MAXIMUM SURFACE WIND - 070 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 300 MI

II. DEVELOPMENT

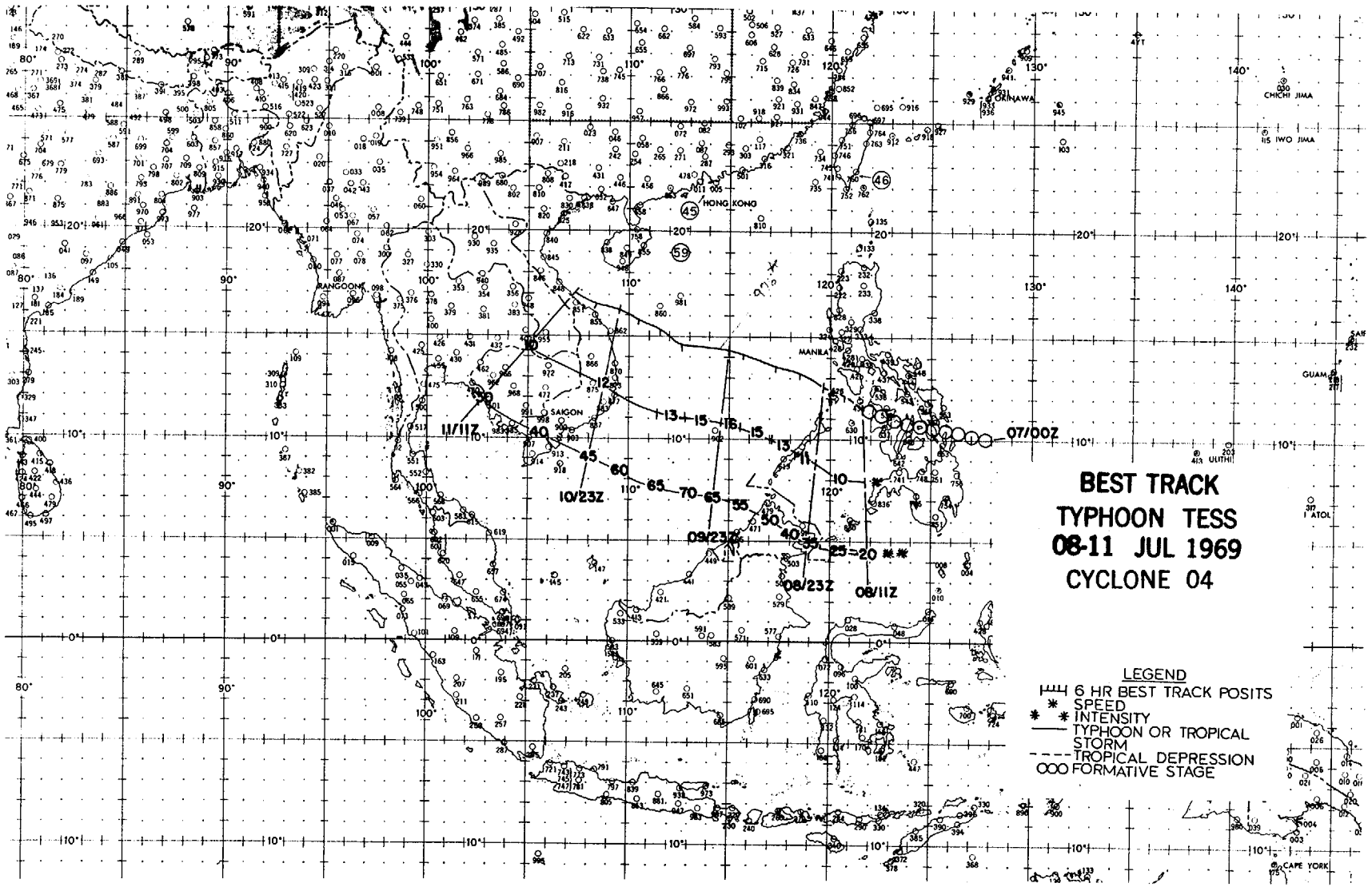
A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX
1. JUNCTION VORTEX AT 050000Z
2. SURFACE PRESSURE LESS THAN 1009 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - NORTHEAST
2. UPON REACHING TYPHOON INTENSITY - EAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND


BEST TRACK
TYPHOON TESS
08-11 JUL 1969
CYCLONE 04
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
HONG KONG
RANGOON
SAIGON
MANILA
OKINAWA
CHICHI JIMA
IWO JIMA
GUAM
ULITHI
ATOL
CAPE YORK
07/00Z
08/23Z
08/11Z
09/23Z
10/23Z
11/11Z

EYE FIXES CYCLONE 04

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL T°/TD	EYE FORM	ORIEN-TATION	EYE DIA	THKNS WALL CLOUD
1	050439Z	08.0N 135.0E	SLTLS	STG B	DIA --	BNDS -							
2	060638Z	08.0N 128.0E	SLTLS	STG B	DIA --	BNDS -							
3	080540Z	11.0N 122.0E	SLTLS	STG X	DIA 02	BNDS 2							
4	090400Z	13.2N 118.8E	54-P----10	500MB	055	045	991	---	01/55	CIRC	----	10	--
5	090445Z	13.2N 118.7E	VW-R----10	700MB	---	---	---	---	--/--	CIRC	----	17	--
6	090638Z	13.0N 118.5E	SLTLS	STG X	DIA 02	BNDS 2							
7	090905Z	13.4N 117.8E	VW-P----10	2230M	---	065	980	---	--/--	----			1-
8	091305Z	13.8N 116.8E	VW-R----10		---	---	---	---	--/--	----			--
9	091400Z	14.0N 116.5E	VW-P----05	700MB	---	---	---	2950	21/13	ELIP	NW-SE	29X25	--
10	092120Z	14.3N 114.4E	54-R---- 0	700MB	055	---	---	3069	--/--	CIRC	----	20	--
11	100000Z	14.5N 113.8E	54-P----05	700MB	082	070	969	2874	19/14	CIRC	----	20	--
12	100215Z	14.6N 113.3E	54-P----05	700MB	065	070	---	2859	20/09	CIRC	----	20	10
13	100737Z	14.0N 111.5E	SLTLS	STG X	DIA 04	BNDS 2							
14	100745Z	14.9N 112.1E	VW-R----20		---	---	---	---	--/--	----			--
15	100840Z	14.9N 112.2E	VW-P----10	0290M	---	070	974	---	29/25	----			--
16	101200Z	15.2N 111.3E	VW-R----10		---	---	---	---	--/--	----			--
17	101400Z	15.6N 111.1E	VW-P----10	700MB	065	---	974	2984	24/15	----			--
18	101500Z	15.8N 111.8E	VW-R------		---	---	---	---	--/--	----			--
19	101725Z	16.0N 110.5E	VW-P----10	700MB	---	---	984	2962	22/15	CIRC	----	40	--
20	102110Z	16.0N 109.8E	54-P----15	700MB	065	---	987	2984	16/12	----			--
21	110000Z	16.5N 109.1E	54-P----05	700MB	070	060	989	2990	20/15	CIRC	----	15	--
22	110245Z	16.6N 108.6E	54-P----05	700MB	065	060	989	3011	16/12	CIRC	----	10	--
23	110254Z	17.0N 108.0E	SLTLS	STG X	DIA 02	BNDS 3							
24	111010Z	17.0N 107.4E	VW-R----05		---	---	---	---	--/--	----			--
25	111030Z	16.9N 107.2E	VW-R----02		---	025	996	---	--/--	----			--

TYPHOON TESS

TROPICAL CYCLONE 04 -- 07/08/1100Z TO 07/11/1100Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
03	082300Z	12.4N	119.9E	12.7N	119.7E	13.7N	118.9E	--------	-	-	--------	-	-	--------
04	090500Z	13.3N	118.7E	13.3N	118.6E	16.2N	115.9E	--------	19.0N	114.2E	--------	22.0N	113.2E	--------
05	091100Z	13.8N	117.6E	13.7N	117.2E	17.3N	114.3E	265-0126	20.9N	112.8E	--------	-	-	--------
06	091700Z	14.4N	115.9E	14.1N	115.6E	18.4N	112.6E	151-0102	22.0N	111.2E	--------	-	-	--------
07	092300Z	14.4N	114.0E	14.4N	114.0E	17.5N	109.0E	098-0282	21.5N	106.3E	--------	-	-	--------
08	100500Z	14.8N	112.7E	14.7N	112.6E	17.7N	108.4E	065-0204	20.3N	106.5E	--------	-	-	--------
09	101100Z	15.2N	111.9E	15.3N	111.6E	17.6N	108.4E	052-0192	20.2N	106.6E	--------	-	-	--------
10	101700Z	15.9N	110.6E	15.9N	110.5E	18.7N	107.4E	039-0192	21.6N	106.1E	--------	-	-	--------
11	102300Z	16.5N	109.7E	16.3N	109.4E	18.7N	107.5E	010-0186	21.6N	106.1E	--------	-	-	--------
12	110500Z	16.8N	108.3E	16.7N	108.3E	20.0N	105.2E	006-0060	-	-	068-0360	-	-	--------

AVERAGE 24 HOUR ERROR - 0168 MI.
AVERAGE 48 HOUR ERROR - 0360 MI.
AVERAGE 72 HOUR ERROR - ---- MI.

TYPHOON VIOLA - 07/21/2300Z TO 07/28/0500Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 26
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 18
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1854 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 897 MBS AT 262100Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2137 M AT 262100Z
3. MAXIMUM SURFACE WIND - 130 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 420 MI

II. DEVELOPMENT

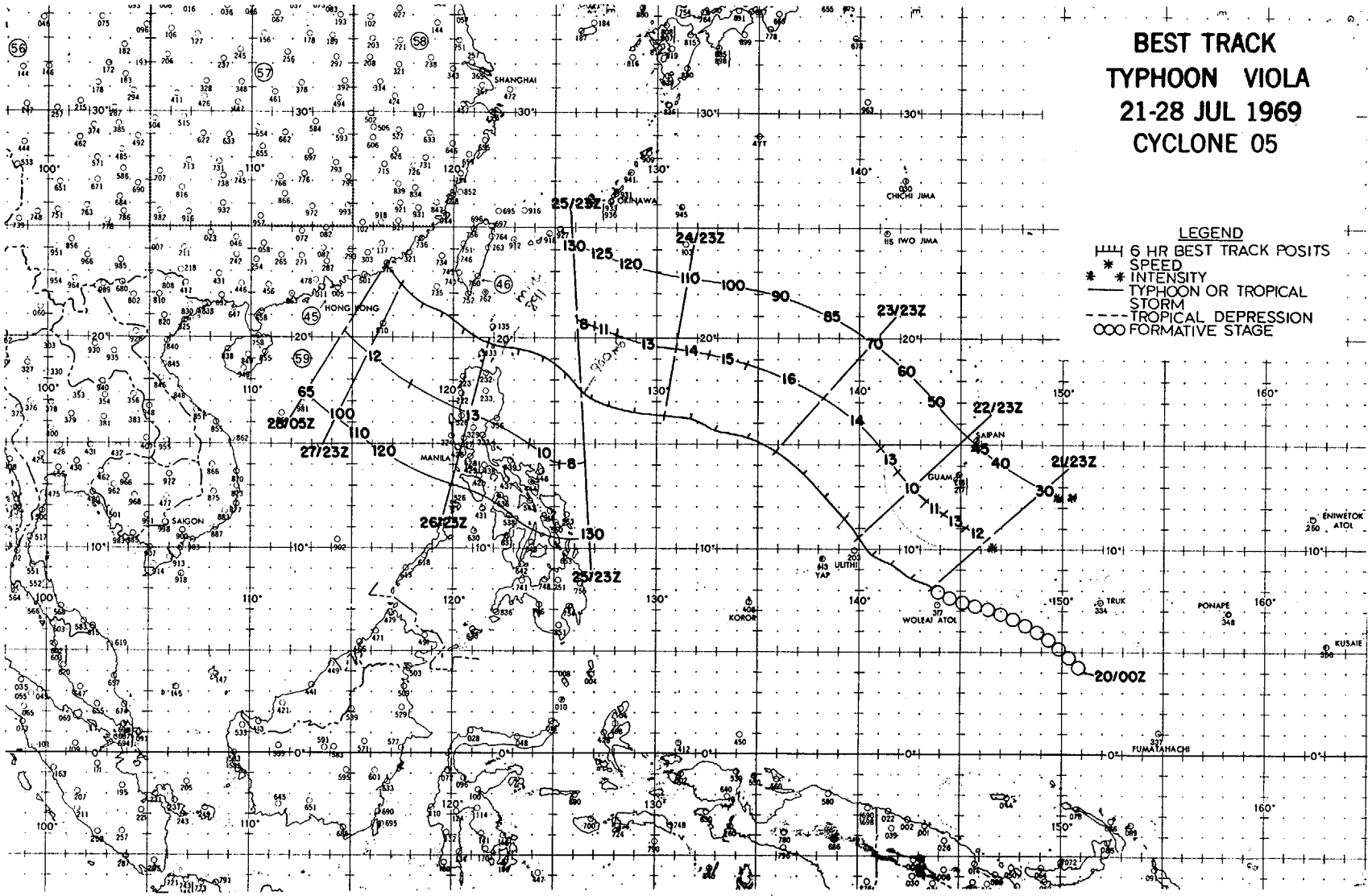
A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX
1. JUNCTION VORTEX AT 180000Z
2. SURFACE PRESSURE LESS THAN 1008 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - EAST
2. UPON REACHING TYPHOON INTENSITY - SOUTHEAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND


BEST TRACK
TYPHOON VIOLA
21-28 JUL 1969
CYCLONE 05
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
25/23Z
24/23Z
23/23Z
22/23Z
21/23Z
20/00Z
26/05Z
27/23Z
26/23Z
25/23Z
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
SAIGON
SAIPAN
GUAM
YAP
ULITHI
WOLEAI ATOL
KOROR
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
FUMATAHACHI

EYE FIXES CYCLONE 05

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL TT/TD	EYE FORM	ORIEN-TATION	EYE DIA	THICK WALL CLOUD
1	210455Z	07.0N 148.0E	SLTLS	STG B	DIA -- BNDS -								
2	220100Z	08.2N 143.5E	54-P----20	0300M	040	035	000	---	25/24	----			--
3	220315Z	08.2N 143.4E	54-P----15	0380M	040	040	999	---	24/24	----			--
4	220359Z	08.0N 144.0E	SLTLS	STG C	DIA -- BNDS -								
5	220800Z	12.2N 138.5E	VW-R----20		---	---	---	---	--/--	----			--
6	220855Z	09.0N 141.8E	VW-P----05	0200M	065	040	994	---	25/25	----			--
7	221447Z	09.8N 141.0E	VW-P----05	0290M	---	040	991	---	26/24	----			--
8	222100Z	10.3N 140.2E	54-P----10	700MB	025	---	992	2993	15/12	ELIP	NW-SE	20X10	--
9	230300Z	11.2N 139.4E	54-P----10	700MB	040	045	992	2999	15/12	ELIP	NW-SE	20X10	--
10	230457Z	12.0N 138.0E	SLTLS	STG C	DIA -- BNDS -								
11	230908Z	12.4N 138.6E	VW-P----05	0280M	---	040	986	998 ---		26/24	CIRC	----	30	--
12	231440Z	13.2N 137.5E	VW-P----05	700MB	---	---	980	998 2993		16/11	CIRC	----	20	10
13	232100Z	14.5N 136.4E	54-P----05	700MB	085	075	971	2871		15/10	CIRC	----	02	03
14	240245Z	15.2N 135.0E	54-P----05	700MB	090	100	952	2658		16/12	CIRC	----	02	03
15	240556Z	16.5N 134.0E	SLTLS	STG X	DIA 02 BNDS 4									
16	240910Z	15.7N 132.9E	VW-R----10		---	055	---	---	--/--	CIRC	----	03	09
17	241205Z	16.0N 132.2E	VW-R----10		---	---	---	---	--/--	CIRC	----	04	--
18	241431Z	16.2N 131.8E	VW-R----12		---	---	---	992 ---		--/--	ELIP	NW-SE	11X08	06
19	242100Z	16.3N 130.7E	54-P----05	700MB	100	080	926	2440		19/14	CIRC	----	10	--
20	250240Z	16.7N 129.3E	54-P----05	700MB	085	100	923	993 2417		18/14	CIRC	----	08	--
21	250504Z	17.0N 128.0E	SLTLS	STG X	DIA 04 BNDS 4									
22	250840Z	16.9N 128.3E	VW-R----05		060	085	---	---		--/--	CIRC	----	25	10
23	251400Z	17.0N 127.2E	VW-R----10		060	---	---	998 ---		--/--	CIRC	----	26	08
24	252100Z	17.2N 126.7E	54-P----05	700MB	100	125	900	2204		26/13	CIRC	----	30	--
25	260215Z	18.0N 125.9E	54-P----10	700MB	118	125	903	992 2237		22/12	CIRC	----	30	15
26	260603Z	18.5N 125.0E	SLTLS	STG X	DIA 05 BNDS 4									
27	260800Z	18.8N 124.8E	VW-R----05		---	090	---	---		--/--	CIRC	----	25	15
28	261400Z	19.6N 123.6E	VW-R----10	700MB	070	---	---	---		--/--	CIRC	----	15	08
29	261530Z	19.6N 122.8E	LND RDR		---	---	---	---		--/--	CIRC	----	13	--
30	261840Z	19.9N 122.2E	ACFT RDR		---	---	---	---		--/--	----			--
31	262100Z	19.7N 122.4E	54-P----05	700MB	110	---	891	891 3137		22/16	CIRC	----	25	04
32	270200Z	20.3N 121.0E	LND RDR		---	---	---	---		--/--	----			--
33	270230Z	20.2N 120.9E	54-P----05	700MB	100	075	907	2231		21/18	CIRC	----	18	--
34	270500Z	20.5N 120.3E	LND RDR		---	---	---	---		--/--	----			--
35	270702Z	21.0N 120.0E	SLTLS	STG X	DIA 05 BNDS 4									
36	270750Z	21.0N 119.8E	VW-R----10		---	---	---	---		--/--	----			--
37	270800Z	20.8N 120.0E	LND RDR		---	---	---	---		--/--	----			--
38	270830Z	21.0N 119.9E	VW-R----05		055	040	---	---		--/--	CIRC	----	18	08
39	270900Z	20.9N 119.8E	LND RDR		---	---	---	---		--/--	----			--
40	271100Z	21.1N 119.6E	LND RDR		---	---	---	---		--/--	----			--
41	271245Z	21.2N 119.4E	VW-R----20		---	---	---	---		--/--	----			--
42	271300Z	21.2N 119.2E	LND RDR		---	---	---	---		--/--	----			--
43	271400Z	21.6N 119.1E	VW-R----05		057	---	---	---		--/--	----			--
44	271400Z	21.3N 119.0E	LND RDR		---	---	---	---		--/--	----			--
45	271500Z	21.4N 118.8E	LND RDR		---	---	---	---		--/--	----			--
46	271700Z	21.7N 118.5E	LND RDR		---	---	---	---		--/--	----			--
47	272000Z	22.1N 118.1E	LND RDR		---	---	---	---		--/--	----			--
48	272103Z	22.1N 117.8E	54-R----10	700MB	070	---	---	---		--/--	CIRC	----	20	--
49	272205Z	22.5N 117.4E	LND RDR		---	---	---	---		--/--	----			--

TYPHOON VIOLA

TROPICAL CYCLONE 05 -- 07/21/2300Z TO 07/28/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
03	221100Z	09.0N	141.3E	09.3N	141.5E	10.6N	136.9E	--------	12.0N	133.0E	--------	-	-	--------
04	221700Z	09.7N	140.5E	09.8N	140.7E	11.9N	136.4E	--------	13.5N	132.8E	--------	15.1N	129.1E	--------
05	222300Z	10.4N	139.9E	10.6N	140.0E	12.5N	136.4E	226-0066	14.7N	132.9E	--------	-	-	--------
06	230500Z	11.3N	139.0E	11.6N	139.2E	13.8N	135.5E	176-0114	16.3N	131.8E	--------	18.5N	128.0E	--------
07	231100Z	12.7N	138.3E	12.6N	138.2E	16.6N	135.3E	211-0138	19.4N	131.4E	--------	-	-	--------
08	231700Z	13.6N	137.4E	13.7N	137.2E	17.1N	134.1E	202-0114	19.9N	130.1E	--------	21.5N	125.5E	--------
09	232300Z	14.9N	135.9E	14.8N	135.9E	18.3N	131.6E	170-0138	20.5N	126.4E	--------	-	-	--------
10	240500Z	15.7N	134.7E	15.4N	134.4E	18.8N	129.5E	147-0108	20.7N	124.0E	--------	22.0N	118.1E	--------
11	241100Z	16.3N	132.5E	15.7N	132.9E	18.3N	125.9E	069-0144	19.3N	119.8E	178-0222	-	-	--------
12	241700Z	16.4N	131.3E	16.2N	131.5E	18.2N	125.5E	070-0150	19.4N	119.8E	156-0174	21.0N	115.0E	--------
13	242300Z	16.4N	130.2E	16.4N	130.3E	17.7N	125.2E	033-0132	19.0N	120.2E	124-0180	-	-	--------
14	250500Z	16.8N	128.8E	16.7N	128.9E	18.1N	123.6E	014-0126	19.7N	118.4E	098-0162	22.5N	113.7E	--------
15	251100Z	17.1N	127.8E	16.9N	127.8E	18.3N	123.0E	307-0132	20.0N	117.4E	054-0252	-	-	--------
16	251700Z	17.3N	126.6E	17.1N	126.9E	18.6N	121.9E	310-0102	20.6N	116.5E	047-0246	24.0N	112.0E	133-0174
17	252300Z	17.3N	126.4E	17.6N	126.3E	18.1N	123.4E	275-0060	18.9N	120.2E	002-0174	-	-	--------
18	260500Z	18.0N	125.5E	18.3N	125.5E	19.5N	122.4E	264-0108	21.0N	118.5E	329-0162	23.3N	115.6E	086-0138
19	261100Z	19.2N	124.1E	19.1N	124.4E	21.4N	119.2E	239-0090	24.7N	114.5E	272-0258	-	-	--------
20	261700Z	19.9N	123.0E	19.5N	123.2E	21.9N	118.2E	234-0090	24.7N	114.5E	269-0192	-	-	047-0174
21	262300Z	20.1N	122.0E	19.8N	121.8E	22.2N	117.3E	138-0132	-	-	242-0102	-	-	--------
22	270500Z	20.4N	120.4E	20.4N	120.6E	22.8N	115.1E	117-0114	-	-	251-0126	-	-	304-0168
23	271100Z	21.0N	119.4E	21.1N	119.6E	22.8N	114.1E	314-0024	-	-	242-0132	-	-	--------
24	271700Z	21.7N	118.5E	21.7N	118.4E	23.8N	114.0E	333-0012	-	-	238-0120	-	-	258-0186
25	272300Z	22.2N	117.4E	22.4N	117.4E	-	-	180-0012	-	-	143-0258	-	-	--------
26	280500Z	23.3N	116.3E	23.3N	116.6E	-	-	249-0078	-	-	134-0144	-	-	253-0162

AVERAGE 24 HOUR ERROR - 0099 MI.
AVERAGE 48 HOUR ERROR - 0181 MI.
AVERAGE 72 HOUR ERROR - 0167 MI.

TYPHOON BETTY - 08/05/0500Z TO 08/08/1100Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 14
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 04
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1242 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 962 MBS AT 080200Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2796M AT 072110Z
3. MAXIMUM SURFACE WIND - 070 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 360 MI

II. DEVELOPMENT

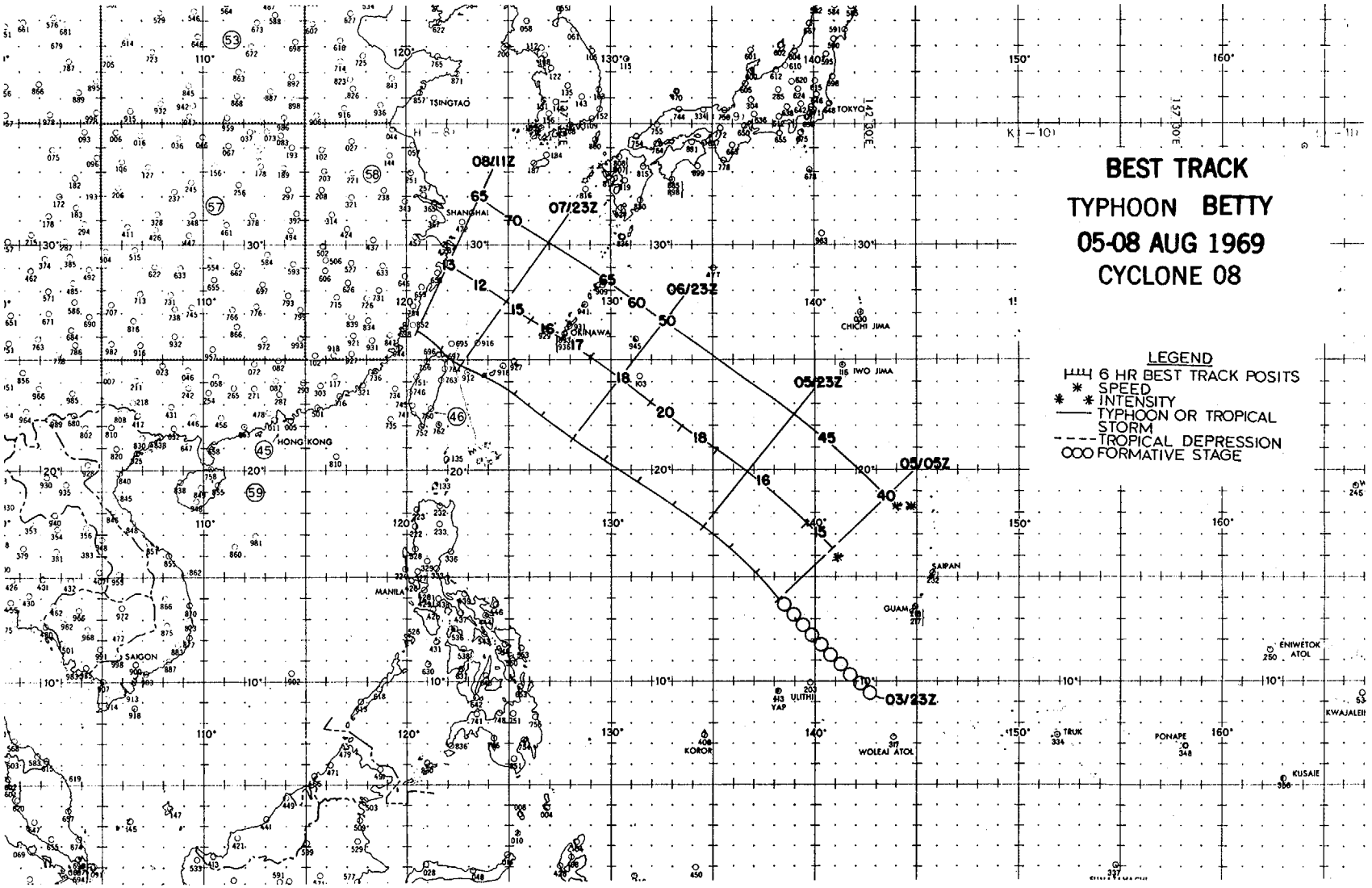
A. INITIAL IMPETUS - UNSTABLE EASTERLY WAVE UNDER 200 MB DIVERGENCE

B. INITIAL SURFACE VORTEX
1. JUNCTION VORTEX AT 021800Z
2. SURFACE PRESSURE LESS THAN 1008 MBS

c. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - NORTHEAST
2. UPON REACHING TYPHOON INTENSITY - EAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND


BEST TRACK
TYPHOON BETTY
05-08 AUG 1969
CYCLONE 08
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
08/11Z
07/23Z
06/23Z
05/23Z
05/05Z
03/23Z
SHANGHAI
TSINGTAO
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
SAIGON
GUAM
SAIPAN
YAP
ULITHI
KOROR
WOLEAI ATOL
ENIWETOK ATOL
TRUK
PONAPE
KUSAIE
KWAJALEIN

EYE FIXES CYCLONE 08

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FIX L'L TT/TD	EYE FORM	ORIEN-TATION	EYE DIA	THKNS WALL CLOUD
1	040230Z	09.9N 142.2E	54-P----30	0460M	030	015	005	---	24/24	CIRC	----	35	--
2	050028Z	13.4N 138.6E	54-P----20	0460M	035	025	001	---	26/24	----			--
3	050556Z	14.2N 137.9E	VW-P----05	0300M	---	055	993	---	27/25	CIRC	----	05	--
4	052126Z	17.1N 134.8E	54-P----15	700MB	055	---	987	2995	14/10	----			E.W.
5	060215Z	17.9N 133.7E	54-P----20	700MB	045	040	989	2987	14/11	----			E.W.
6	060517Z	18.0N 132.5E	SLTLS	STG C	DIA --	BNDS -							
7	060800Z	18.9N 131.1E	VW-R----20		---	---	---	---	--/--	----			--
8	060930Z	19.6N 131.1E	VW-P----20	0240M	040	045	985	---	25/23	CIRC	----	20	--
9	061445Z	20.3N 130.2E	VW-P----10	700MB	055	---	---	---	13/09	CIRC	----	20	--
10	062100Z	21.2N 128.5E	54-P----03	700MB	045	050	980	2951	15/11	CIRC	----	12	03
11	070205Z	22.0N 127.2E	54-P----03	700MB	060	070	975	2897	16/12	CIRC	----	12	03
12	070500Z	22.6N 126.7E	LND RDR		---	---	---	---	--/--	----			--
13	070600Z	22.9N 126.5E	LND RDR		---	---	---	---	--/--	----			--
14	070615Z	23.0N 126.5E	SLTLS	STG X	DIA 02	BNDS 3							
15	070630Z	22.0N 126.7E	LND RDR		---	---	---	---	--/--	----			--
16	070700Z	23.0N 126.2E	LND RDR		---	---	---	---	--/--	----			--
17	070800Z	23.1N 126.0E	LND RDR		---	---	---	---	--/--	----			--
18	070900Z	23.3N 125.8E	LND RDR		---	---	---	---	--/--	----			--
19	070900Z	23.3N 125.8E	LND RDR		---	---	---	---	--/--	----			--
20	070900Z	23.3N 125.7E	LND RDR		---	---	---	---	--/--	----			--
21	070900Z	23.3N 125.6E	VW-P----05	0230M	075	070	973	---	25/25	CIRC	----	12	06
22	071100Z	23.4N 125.1E	LND RDR		---	---	---	---	--/--	----			--
23	071200Z	23.6N 125.0E	LND RDR		---	---	---	---	--/--	----			--
24	071300Z	23.7N 124.7E	LND RDR		---	---	---	---	--/--	----			--
25	071400Z	23.9N 124.3E	LND RDR		---	---	---	---	--/--	----			--
26	071400Z	24.0N 124.2E	LND RDR		---	---	---	---	--/--	----			--
27	071410Z	23.8N 124.3E	VW-R----10		---	---	---	---	--/--	CIRC	----	15	--
28	071500Z	23.9N 124.0E	LND RDR		---	---	---	---	--/--	----			--
29	071600Z	24.1N 123.6E	LND RDR		---	---	---	---	--/--	----			--
30	072000Z	24.5N 122.9E	LND RDR		---	---	---	---	--/--	----			--
31	072110Z	24.6N 122.8E	54-P----02	500MB	080	---	965	2796	02/52	CIRC	----	16	05
32	072200Z	24.7N 122.6E	LND RDR		---	---	---	---	--/--	----			--
33	072300Z	24.8N 122.7E	LND RDR		---	---	---	---	--/--	----			--
34	080200Z	25.4N 122.0E	LND RDR		---	---	---	---	--/--	----			--
35	080200Z	25.2N 122.0E	LND RDR		---	---	---	---	--/--	----			--
36	080200Z	25.4N 122.3E	54-P----02	500MB	070	---	962	---	02/56	CIRC	----	15	05
37	080230Z	25.5N 121.8E	LND RDR		---	---	---	---	--/--	----			--
38	080230Z	25.4N 121.9E	LND RDR		---	---	---	---	--/--	----			--
39	080430Z	25.8N 121.4E	LND RDR		---	---	---	---	--/--	----			--
40	080500Z	25.8N 121.3E	LND RDR		---	---	---	---	--/--	----			--
41	080600Z	25.9N 121.0E	LND RDR		---	---	---	---	--/--	----			--
42	080700Z	26.0N 120.8E	LND RDR		---	---	---	---	--/--	----			--
43	080800Z	26.2N 120.6E	LND RDR		---	---	---	---	--/--	----			--
44	080930Z	26.2N 120.5E	LND RDR		---	---	---	---	--/--	----			--
45	081000Z	26.1N 120.2E	LND RDR		---	---	---	---	--/--	----			--

TYPHOON BETTY

TROPICAL CYCLONE 08 -- 08/05/0500Z TO 08/08/1100Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
01	050500Z	14.0N	138.0E	14.0N	138.1E	17.8N	134.9E	--------	20.5N	131.4E	--------	23.0N	126.9E	--------
02	051100Z	15.0N	137.2E	15.2N	137.0E	18.7N	134.0E	--------	21.4N	129.8E	--------	-	-	--------
03	051700Z	16.0N	136.5E	16.4N	135.8E	19.4N	133.0E	--------	22.3N	129.0E	--------	25.0N	125.0E	--------
04	052300Z	17.3N	134.5E	17.4N	134.5E	20.9N	130.1E	--------	24.0N	126.2E	--------	-	-	--------
05	060500Z	18.6N	133.0E	18.4N	133.0E	22.8N	128.4E	108-0108	26.9N	125.6E	--------	31.9N	125.8E	--------
06	061100Z	20.0N	130.7E	19.6N	131.2E	24.2N	125.6E	109-0162	28.4N	122.2E	--------	-	-	--------
07	061700Z	20.6N	129.8E	20.6N	129.6E	24.2N	125.4E	110-0204	27.7N	121.7E	--------	-	-	--------
08	062300Z	21.5N	128.1E	21.6N	128.0E	25.9N	122.5E	110-0120	30.1N	118.0E	--------	-	-	--------
09	070500Z	22.6N	126.5E	22.6N	126.5E	26.7N	120.8E	084-0102	-	-	115-0294	-	-	--------
10	071100Z	23.6N	125.0E	23.5N	125.1E	27.7N	119.4E	030-0048	-	-	116-0282	-	-	--------
11	071700Z	24.6N	123.6E	24.2N	123.6E	28.4N	118.6E	090-0096	-	-	111-0312	-	-	--------
12	072300Z	24.8N	122.4E	24.8N	122.6E	26.6N	117.1E	360-0066	-	-	104-0192	-	-	--------
13	080500Z	25.7N	121.7E	25.7N	121.6E	28.2N	117.9E	325-0072	-	-	072-0222	-	-	119-0330
14	081100Z	26.3N	120.1E	26.3N	120.3E	28.4N	115.9E	330-0096	-	-	038-0156	-	-	--------

AVERAGE 24 HOUR ERROR - 0107 MI.
AVERAGE 48 HOUR ERROR - 0243 MI.
AVERAGE 72 HOUR ERROR - 0330 MI.

TYPHOON CORA - 08/14/2300Z TO 08/23/0500Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 34
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 15
3. DIATANCE TRAVELED DURING WARNING PERIOD - 2226 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 948 MBS AT 192100Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2652M AT 200230Z
3. MAXIMUM SURFACE WIND - 085 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 330 MI

II. DEVELOPMENT

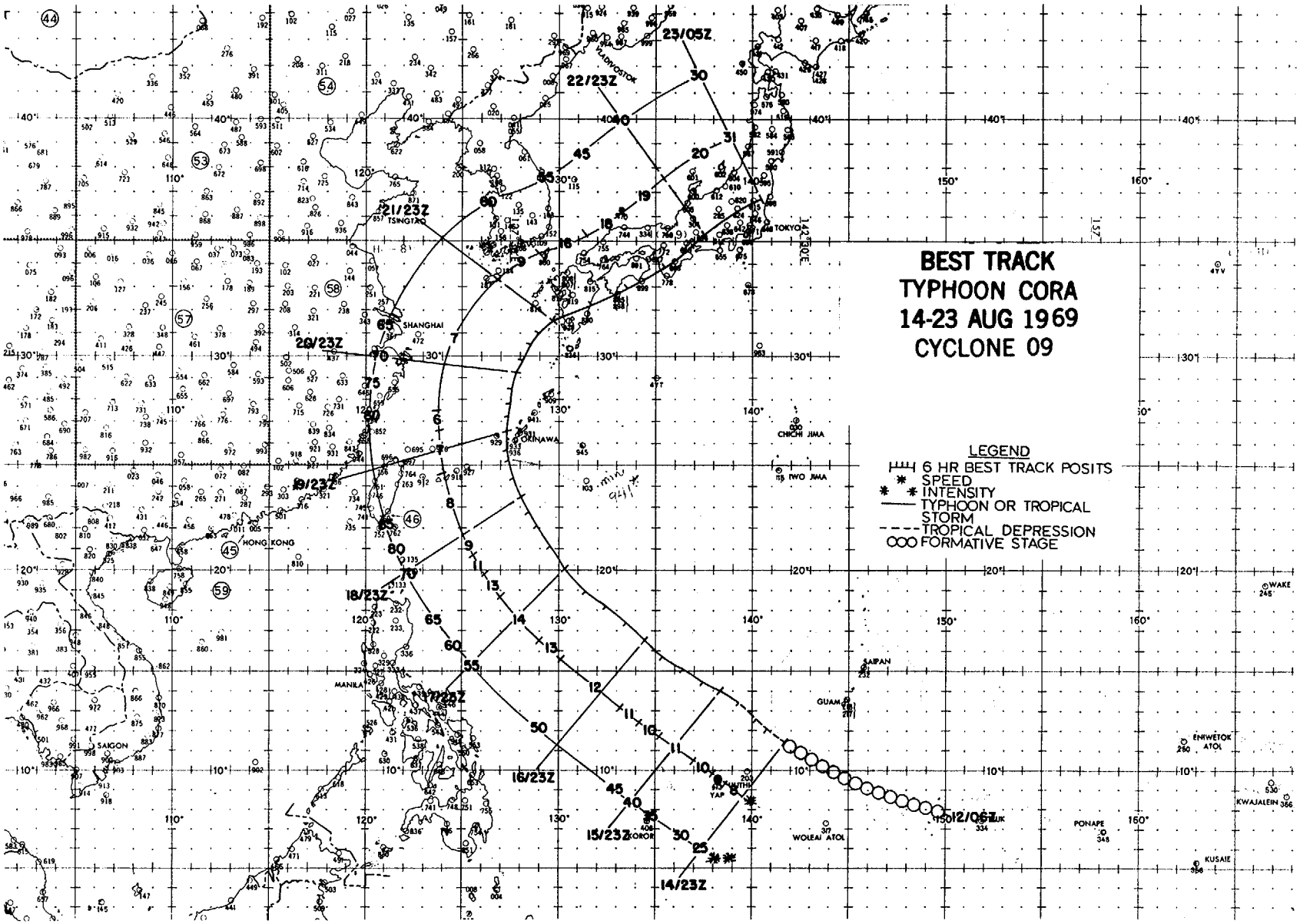
A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX
1. JUNCTION VORTEX AT 120600Z
2. SURFACE PRESSURE LESS THAN 1007 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - SOUTHEAST
2. UPON REACHING TYPHOON INTENSITY - SOUTHEAST

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL


BEST TRACK
TYPHOON CORA
14-23 AUG 1969
CYCLONE 09
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
23/05Z
22/23Z
21/23Z
20/23Z
19/23Z
18/23Z
17/23Z
16/23Z
15/23Z
14/23Z
12/05Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
OKINAWA
HONG KONG
MANILA
SAIGON
TOKYO
CHICHI JIMA
IWO JIMA
WAKE
SAIPAN
GUAM
YAP
WOLEAI ATOL
KOROR
ENIWETOK ATOL
KWAJALEIN
PONAPE
KUSAIE

EYE FIXES CYCLONE 09

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	OBS FLT LVL WIND	OBS SFC WIND	OBS MIN SLP	MIN 700MB HGT	FLT LVL T/TD	EYE POSN	ORIEN-TATION	EYE DIA	[illegible] WALL CLOUD
1	1304227	10.5N 145.5E	SLTLS	STG B	01A -- BNDS -								
2	1401357	10.1N 144.2E	54-P----30	0310M	015	015	003	---	24/22	----			--
3	1405217	09.0N 142.0E	SLTLS	STG B	01A -- BNDS -								
4	1422257	11.5N 141.7E	54-P----08	0250M	035	030	998	---	25/24	----			[illegible]
5	1503007	11.8N 141.1E	54-P----10	0300M	035	025	996	---	24/24	----			[illegible]
6	1504257	12.0N 141.0E	SLTLS	STG B	01A -- BNDS -								
7	1508507	12.7N 140.2E	VW-P----10	0320M	045	035	996	---	25/22	CIRC	----	20	05
8	1514557	13.2N 139.4E	VW-P----05	0320M	030	030	994	---	25/21	----			[illegible]
9	1521007	13.7N 138.7E	54-P----06	0500M	045	030	991	---	26/24	----			[illegible]
10	1603007	14.4N 137.7E	54-P----06	700MB	045	050	990	3021	12/10	CIRC	----	05	--
11	1605237	15.0N 136.0E	SLTLS	STG C	01A -- BNDS -								
12	1607507	14.9N 136.6E	VW-R----10		---	---	---	---	--/--	----			--
13	1608207	14.6N 137.0E	VW-R----10	0300M	037	050	---	---	--/--	CIRC	----	18	[illegible]
14	1611097	15.0N 136.4E	VW-R----05		---	---	---	---	--/--	CIRC	----	06	--
15	1615007	15.4N 135.6E	VW-R----05		---	---	---	---	--/--	CIRC	----	07	[illegible]
16	1621007	16.7N 134.5E	54-P----08	700MB	052	040	989	2996	16/10	----			--
17	1702457	17.0N 133.8E	54-P----08	700MB	050	050	989	3008	16/10	----			--
18	1704317	17.5N 133.0E	SLTLS	STG X	01A 02 BNDS 2								
19	1708007	17.9N 133.0E	VW-R----10		---	---	---	---	--/--	----			--
20	1709257	18.3N 132.7E	VW-P----10	0210M	---	050	987	---	25/23	CIRC	----	20	12
21	1712007	18.8N 132.3E	VW-R----10		---	---	---	---	--/--	----			--
22	1714007	18.5N 132.0E	VW-P----15	700MB	080	---	---	2972	16/11	CIRC	----	38	--
23	1721007	19.5N 130.5E	54-P----12	700MB	045	---	977	2914	16/12	CIRC	----	25	--
24	1802157	20.7N 129.8E	54-P----07	700MB	065	060	972	2875	20/14	CIRC	----	20	10
25	1805307	21.5N 130.0E	SLTLS	STG X	01A 03 BNDS 2			980					
26	1809207	21.7N 129.2E	VW-P----05	0350M	065	060	969	2910	27/24	CIRC	----	25	--
27	1812107	22.1N 129.0E	VW-R----07		---	---	---	980	--/--	CIRC	----	30	03
28	1814507	22.3N 128.7E	VW-P----04	700MB	070	---	---	2917	19/10	CIRC	----	30	10
29	1817557	22.9N 128.2E	LND RDR		---	---	---	2964	--/--	----			--
30	1821007	23.3N 128.0E	54-P----05	700MB	080	---	963	2777	17/09	CIRC	----	25	04
31	1900017	24.0N 128.0E	LND RDR		---	---	---	2953	--/--	----			--
32	1902007	24.0N 127.8E	54-P----05	700MB	090	050	952	2722	17/09	CIRC	----	20	05
33	1906297	24.5N 127.5E	SLTLS	STG X	01A 03 BNDS 4								
34	1907397	24.8N 127.5E	LND RDR		---	---	---	---	--/--	CIRC	----	20	13
35	1909007	24.6N 127.1E	VW-R----20		---	---	---	---	--/--	CIRC	----	15	10
36	1909207	24.8N 127.5E	LND RDR		---	---	---	---	--/--	----			--
37	1911007	25.2N 127.5E	LND RDR		---	---	---	941 ---	--/--	----			--
38	1911357	25.4N 127.4E	VW-P----10	700MB	090	---	944	2576	21/14	CIRC	----	15	12
39	1912007	25.4N 127.4E	LND RDR		---	---	---	---	--/--	----			--
40	1913007	25.4N 127.3E	LND RDR		---	---	---	---	--/--	----			--
41	1913207	25.2N 127.3E	LND RDR		---	---	---	---	--/--	----			--
42	1914007	25.5N 127.2E	LND RDR		---	---	---	---	--/--	----			--
43	1914107	25.5N 127.5E	VW-R----10		---	---	---	---	--/--	CIRC	----	18	06
44	1915007	25.5N 127.2E	LND RDR		---	---	---	---	--/--	----			--
45	1918307	25.8N 127.2E	LND RDR		---	---	---	---	--/--	----			--
46	1921007	26.1N 127.2E	LND RDR		---	---	---	---	--/--	CIRC	----	17	--
47	1921007	26.2N 127.2E	54-P----07	700MB	080	---	948	2658	16/12	CIRC	----	15	--
48	2002307	26.9N 127.2E	54-P----05	700MB	065	080	948	2652	17/12	CIRC	----	15	--
49	2005327	27.5N 127.0E	SLTLS	STG X	01A 05 BNDS 4								
50	2006207	27.3N 127.2E	LND RDR		---	---	---	---	--/--	----			--

EYE FIXES CYCLONE 09

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL FT/TD	EYE FORM	ORIEN-TATION	EYE DIA	THIN WALL CLOUD
51	200855Z	27.6N 127.2E	LND RDR		---	---	---	---	--/--	----			--
52	200920Z	27.6N 127.4E	VW-R----04		---	---	---	---	--/--	----			F.N.
53	201010Z	27.8N 127.1E	VW-P----05	700MB	---	080	---	2731	21/13	----			--
54	201415Z	28.1N 127.8E	VW-R----05		---	---	---	---	--/--	CIRC	----	25	09
55	201436Z	28.0N 127.4E	LND RDR		---	---	---	---	--/--	CIRC	----	18	05
56	201610Z	28.2N 127.7E	LND RDR		---	---	---	---	--/--	CIRC	----	20	06
57	202100Z	28.8N 127.6E	54-P-----	700MB	075	---	958	2725	16/10	CIRC	----	15	05
58	210215Z	26.9N 127.0E	LND RDR		---	---	---	---	--/--	----			--
59	210230Z	29.2N 128.0E	54-P----03	700MB	080	085	961	2771	17/09	----			05
60	210300Z	27.0N 127.1E	LND RDR		---	---	---	---	--/--	----			--
61	210400Z	27.0N 127.2E	LND RDR		---	---	---	---	--/--	----			--
62	210440Z	29.5N 128.0E	SLTLS	STG X	DIA 03	BNDS 3							
63	210520Z	27.2N 127.0E	LND RDR		---	---	---	---	--/--	----			--
64	210600Z	27.2N 126.9E	LND RDR		---	---	---	---	--/--	----			--
65	210900Z	29.9N 128.2E	VW-R----15		---	---	---	---	--/--	----			--
66	210930Z	30.2N 128.0E	VW-R----10		---	---	---	---	--/--	CIRC	----	20	--
67	211100Z	30.2N 128.4E	VW-P----05	700MB	075	055	960	2738	18/11	CIRC	----	25	05
68	211425Z	30.7N 128.6E	VW-R----10		---	---	---	---	--/--	ELIP	NE-SW	35X20	--
69	212000Z	31.2N 129.1E	LND RDR		---	---	---	---	--/--	----			--
70	212000Z	31.1N 129.2E	LND RDR		---	---	---	---	--/--	----			--
71	212100Z	31.2N 129.2E	54-P----05	500MB	086	---	963	2761	04/00	CIRC	----	40	--
72	212100Z	31.3N 129.3E	LND RDR		---	---	---	---	--/--	----			--
73	212200Z	31.3N 129.4E	LND RDR		---	---	---	---	--/--	----			--
74	212200Z	31.4N 129.6E	LND RDR		---	---	---	---	--/--	----			--
75	212300Z	31.3N 129.6E	LND RDR		---	---	---	---	--/--	----			--
76	220000Z	31.5N 129.8E	LND RDR		---	---	---	---	--/--	----			--
77	220020Z	31.2N 130.2E	54-P----05	500MB	086	---	965	---	04/00	CIRC	----	30	--
78	220100Z	31.5N 130.3E	LND RDR		---	---	---	---	--/--	----			--
79	220200Z	31.6N 130.6E	LND RDR		---	---	---	---	--/--	----			--
80	220300Z	31.7N 130.9E	LND RDR		---	---	---	---	--/--	----			--
81	220400Z	31.9N 131.3E	LND RDR		---	---	---	---	--/--	----			--
82	220500Z	32.0N 131.4E	LND RDR		---	---	---	---	--/--	----			--
83	220539Z	32.0N 131.5E	SLTLS	STG X	DIA 03	BNDS 3							
84	220700Z	32.4N 132.0E	LND RDR		---	---	---	---	--/--	----			--
85	220800Z	32.6N 132.4E	LND RDR		---	---	---	---	--/--	----			--
86	220900Z	32.6N 132.5E	LND RDR		---	---	---	---	--/--	----			--
87	220900Z	32.5N 132.8E	VW-R----07		---	---	---	---	--/--	----			05
88	221100Z	32.9N 133.2E	LND RDR		---	---	---	---	--/--	----			--
89	221200Z	32.9N 133.3E	LND RDR		---	---	---	---	--/--	----			--
90	221210Z	33.0N 133.5E	VW-R----10		---	---	---	---	--/--	----			--
91	221400Z	33.1N 134.2E	VW-R----02		---	---	---	---	--/--	----			F.S.
92	221400Z	33.1N 134.1E	LND RDR		---	---	---	---	--/--	----			--
93	221500Z	33.5N 134.6E	LND RDR		---	---	---	---	--/--	----			--
94	221600Z	33.7N 134.9E	LND RDR		---	---	---	---	--/--	----			--
95	221700Z	33.8N 135.2E	LND RDR		---	---	---	---	--/--	----			--
96	221800Z	34.1N 135.4E	LND RDR		---	---	---	---	--/--	----			--
97	221900Z	34.3N 136.0E	LND RDR		---	---	---	---	--/--	----			--
98	222000Z	34.5N 136.2E	LND RDR		---	---	---	---	--/--	----			--
99	222100Z	34.6N 136.4E	LND RDR		---	---	---	---	--/--	----			--
100	222115Z	35.0N 136.2E	54-P----10	500MB	080	---	---	---	55/56	----			W.F.O.

TYPHOON CORA

TROPICAL CYCLONE 09 -- 08/14/2300Z TO 08/23/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR	48 HR FCST		48 HR ERROR	72 HR FCST		72 HR ERROR
		LAT	LONG	LAT	LONG	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST	LAT	LONG	DEG DIST
04	151700Z	13.4N	139.1E	13.4N	139.2E	15.9N	134.5E	--------	18.1N	128.4E	--------	20.0N	123.1E	--------
05	152300Z	13.9N	138.5E	14.0N	138.2E	16.1N	135.3E	104-0020	18.1N	130.2E	--------	-	-	--------
06	160500Z	14.6N	137.4E	14.5N	137.4E	17.7N	133.0E	236-0072	20.1N	126.7E	--------	22.0N	121.1E	--------
07	161100Z	15.1N	136.5E	15.1N	136.4E	17.4N	132.1E	291-0096	19.5N	126.2E	--------	-	-	--------
08	161700Z	15.7N	135.2E	15.8N	135.3E	17.9N	130.3E	278-0042	20.0N	124.6E	--------	21.9N	119.2E	--------
09	162300Z	16.8N	134.0E	16.6N	134.4E	19.5N	127.9E	122-0054	21.4N	122.0E	--------	-	-	--------
10	170500Z	17.2N	133.4E	17.4N	133.5E	19.1N	128.9E	306-0030	21.1N	123.3E	--------	23.3N	118.3E	--------
11	171100Z	18.4N	132.2E	18.2N	132.4E	21.0N	127.0E	195-0048	22.8N	121.3E	--------	-	-	--------
12	171700Z	19.0N	131.6E	19.0N	131.2E	21.1N	126.8E	217-0078	22.8N	121.1E	251-0162	24.4N	115.7E	--------
13	172300Z	19.6N	130.0E	20.0N	130.2E	21.4N	124.5E	257-0126	23.3N	119.3E	180-0114	-	-	--------
14	180500Z	21.0N	129.4E	21.2N	129.5E	24.7N	125.4E	194-0126	27.6N	121.5E	248-0168	-	-	--------
15	181100Z	22.0N	128.9E	22.1N	128.9E	25.4N	126.6E	238-0120	29.2N	125.2E	224-0216	-	-	--------
16	181700Z	22.6N	128.5E	22.9N	128.4E	26.0N	126.2E	218-0132	30.0N	125.0E	231-0270	34.2N	127.7E	240-0336
17	182300Z	23.6N	127.8E	23.6N	128.1E	27.4N	126.4E	237-0234	32.5N	126.8E	249-0360	-	-	--------
18	190500Z	24.4N	127.6E	24.4N	127.7E	27.5N	126.9E	278-0120	29.0N	126.8E	231-0306	33.0N	127.8E	249-0384
19	191100Z	25.0N	127.4E	25.2N	127.4E	26.9N	127.0E	285-0042	28.6N	126.9E	247-0360	-	-	--------
20	191700Z	25.8N	127.2E	25.8N	127.3E	27.8N	126.8E	282-0054	29.5N	126.7E	243-0384	32.2N	127.3E	243-0498
21	192300Z	26.2N	127.1E	26.5N	127.2E	27.8N	126.8E	322-0066	29.3N	126.7E	247-0468	-	-	--------
22	200500Z	27.1N	127.0E	27.2N	127.2E	30.0N	127.4E	326-0018	33.2N	130.5E	274-0300	35.5N	137.3E	245-0534
23	201100Z	27.9N	127.1E	27.8N	127.3E	30.7N	128.2E	193-0054	33.5N	131.8E	307-0132	-	-	--------
24	201700Z	28.3N	127.6E	28.5N	127.5E	31.1N	130.0E	221-0054	33.6N	134.2E	305-0150	35.7N	140.4E	249-0678
25	202300Z	29.1N	127.8E	29.2N	127.8E	31.8N	130.2E	210-0096	34.4N	135.0E	346-0198	-	-	--------
26	210500Z	29.7N	128.2E	29.8N	128.1E	32.8N	131.6E	288-0036	35.5N	137.8E	234-0078	44.0N	145.0E	--------
27	211100Z	30.4N	128.3E	30.5N	128.4E	33.3N	131.2E	333-0012	36.0N	137.2E	215-0138	-	-	--------
28	211700Z	31.0N	128.8E	31.0N	128.9E	33.7N	131.9E	084-0054	36.8N	137.6E	232-0144	42.3N	143.0E	342-0198
29	212300Z	31.3N	129.6E	31.5N	129.7E	33.6N	136.7E	054-0030	39.2N	145.4E	229-0198	-	-	--------
30	220500Z	31.9N	131.5E	32.1N	131.5E	35.8N	139.2E	009-0042	42.3N	145.0E	323-0078	-	-	286-0192
31	221100Z	33.0N	133.3E	33.0N	133.4E	40.0N	140.0E	279-0108	-	-	291-0078	-	-	--------
32	221700Z	33.7N	135.0E	33.9N	135.4E	39.8N	141.5E	267-0174	-	-	254-0060	-	-	256-0420
33	222300Z	35.2N	137.1E	35.2N	137.2E	-	-	195-0096	-	-	247-0114	-	-	--------

AVERAGE 24 HOUR ERROR - 0077 MI.
AVERAGE 48 HOUR ERROR - 0203 MI.
AVERAGE 72 HOUR ERROR - 0405 MI.

TYPHOON DORIS - 08/31/0500Z TO 09/02/0500Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 09
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 03
3. DISTANCE TRAVELED DURING WARNING PERIOD - 612 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 973 MBS AT 010250Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2865 M AT 010250Z
3. MAXIMUM SURFACE WIND - 065 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 240 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX

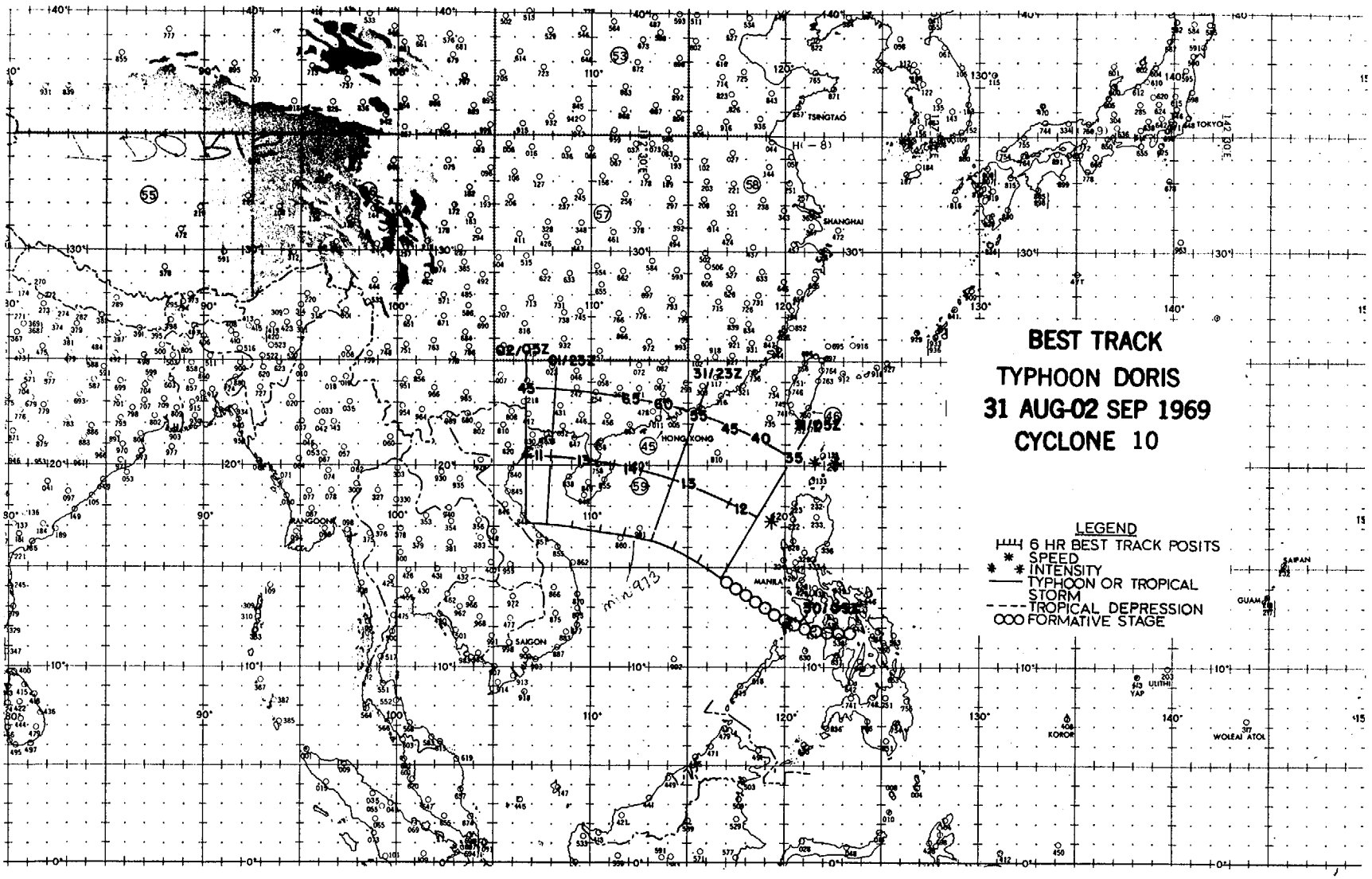
1. INDUCED VORTEX AT 300600Z
2. SURFACE PRESSURE LESS THAN 1006 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - NORTHEAST
2. UPON REACHING TYPHOON INTENSITY - NORTHEAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND


BEST TRACK
TYPHOON DORIS
31 AUG-02 SEP 1969
CYCLONE 10
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
02/05Z
01/23Z
31/23Z
31/05Z
30/23Z
HONG KONG
SHANGHAI
TSINGTAO
TOKYO
MANILA
SAIGON
RANGOON
YAP
KOROR
WOLEAI ATOL
GUAM
SAIPAN
m.n.973

EYE FIXES CYCLONE 10

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	OBS FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL TT/TD	EYE FORM	ORIEN-TATION	EYE DIA	THKNS WALL CLOUD
1	300543Z	12.0N 121.0E	SLTLS	STG C	DIA -- BNDS -								
2	310445Z	14.6N 116.7E	54-P----08	700MB	050	040	992	3011	12/12	----			N.F.B.
3	310637Z	14.5N 117.0E	SLTLS	STG C	DIA -- BNDS -								
4	311536Z	16.1N 114.2E	VW-R----20		---	---	---	---	--/--	----			--
5	311626Z	15.9N 114.2E	VW-P----05	700MB	---	---	995	3055	11/09	CIRC	----	30	--
6	312020Z	16.2N 113.6E	54-P----10	700MB	031	---	981	2935	15/12	----			F.B.
7	010250Z	16.6N 112.0E	54-P---- 5	700MB	065	045	973	2865	16/12	----			F.B.
8	010740Z	17.0N 111.0E	SLTLS	STG X	DIA 04 BNDS 2								
9	010910Z	16.6N 110.8E	VW-R----10	700MB	---	---	---	---	--/--	CIRC	----	16	--
10	010935Z	16.7N 110.5E	LND RDR		---	---	---	---	--/--	CIRC	----	30	10
11	011035Z	16.8N 110.3E	LND RDR		---	---	---	---	--/--	CIRC	----	24	10
12	011205Z	16.9N 110.1E	VW-R----10	700MB	---	---	---	---	--/--	CIRC	----	17	--
13	011245Z	16.8N 110.0E	LND RDR		---	---	---	---	--/--	CIRC	----	24	15
14	011335Z	16.9N 109.8E	LND RDR		---	---	---	---	--/--	CIRC	----	20	10
15	011400Z	16.9N 109.8E	VW-R----10	700MB	---	---	---	---	--/--	CIRC	----	16	--
16	011435Z	16.7N 109.6E	LND RDR		---	---	---	---	--/--	CIRC	----	18	10
17	011535Z	17.0N 109.3E	LND RDR		---	---	---	---	--/--	CIRC	----	20	10
18	011635Z	17.0N 109.1E	LND RDR		---	---	---	---	--/--	CIRC	----	16	10
19	011735Z	17.1N 108.9E	LND RDR		---	---	---	---	--/--	CIRC	----	20	15
20	011135Z	17.1N 110.0E	LND RDR		---	---	---	---	--/--	CIRC	----	12	10
21	011835Z	17.1N 108.7E	LND RDR		---	---	---	---	--/--	----			--
22	011935Z	17.2N 108.4E	LND RDR		---	---	---	---	--/--	----			--
23	012035Z	17.2N 108.2E	LND RDR		---	---	---	---	--/--	----			--
24	012135Z	17.2N 108.0E	LND RDR		---	---	---	---	--/--	----			--
25	012235Z	17.1N 107.8E	LND RDR		---	---	---	---	--/--	CIRC	----	05	--
26	012335Z	17.0N 107.6E	LND RDR		---	---	---	---	--/--	CIRC	----	03	--
27	020035Z	16.9N 107.5E	LND RDR		---	---	---	---	--/--	----			--
28	020135Z	17.0N 107.2E	LND RDR		---	---	---	---	--/--	----			--
29	020230Z	17.0N 107.0E	LND RDR		---	---	---	---	--/--	----			--

TYPHOON DORIS

TROPICAL CYCLONE 10 -- 08/31/0500Z TO 09/02/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
01	310500Z	14.6N	116.6E	14.6N	116.6E	16.2N	112.0E	--------	17.7N	107.4E	--------	-	-	--------
02	311100Z	15.0N	115.6E	15.3N	115.5E	16.5N	110.9E	--------	18.2N	106.3E	--------	-	-	--------
03	311700Z	15.9N	114.0E	15.9N	114.3E	17.8N	109.7E	--------	19.3N	106.5E	--------	-	-	--------
04	312300Z	16.4N	113.1E	16.4N	113.1E	18.7N	108.7E	--------	21.0N	104.2E	--------	-	-	--------
05	010500Z	16.8N	111.5E	16.5N	111.6E	18.6N	106.4E	134-0024	-	-	--------	-	-	--------
06	011100Z	16.8N	110.3E	16.7N	110.3E	17.4N	105.8E	111-0030	-	-	--------	-	-	--------
07	011700Z	17.0N	108.9E	17.0N	109.0E	-	-	037-0060	-	-	--------	-	-	--------
08	012300Z	17.2N	107.6E	17.0N	107.7E	-	-	028-0114	-	-	--------	-	-	--------
09	020500Z	17.0N	106.6E	17.1N	106.7E	-	-	352-0090	-	-	046-0048	-	-	--------

AVERAGE 24 HOUR ERROR - 0063 MI.
AVERAGE 48 HOUR ERROR - 0048 MI.
AVERAGE 72 HOUR ERROR - ---- MI.

TYPHOON ELSIE - 09/19/0500Z TO 09/27/1100Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 34
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 26
3. DISTANCE TRAVELED DURING WARNING PERIOD - 2760 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 890 MBS AT 240300Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2140 M AT 240300Z
3. MAXIMUM SURFACE WIND - 150 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 600 MI

II. DEVELOPMENT

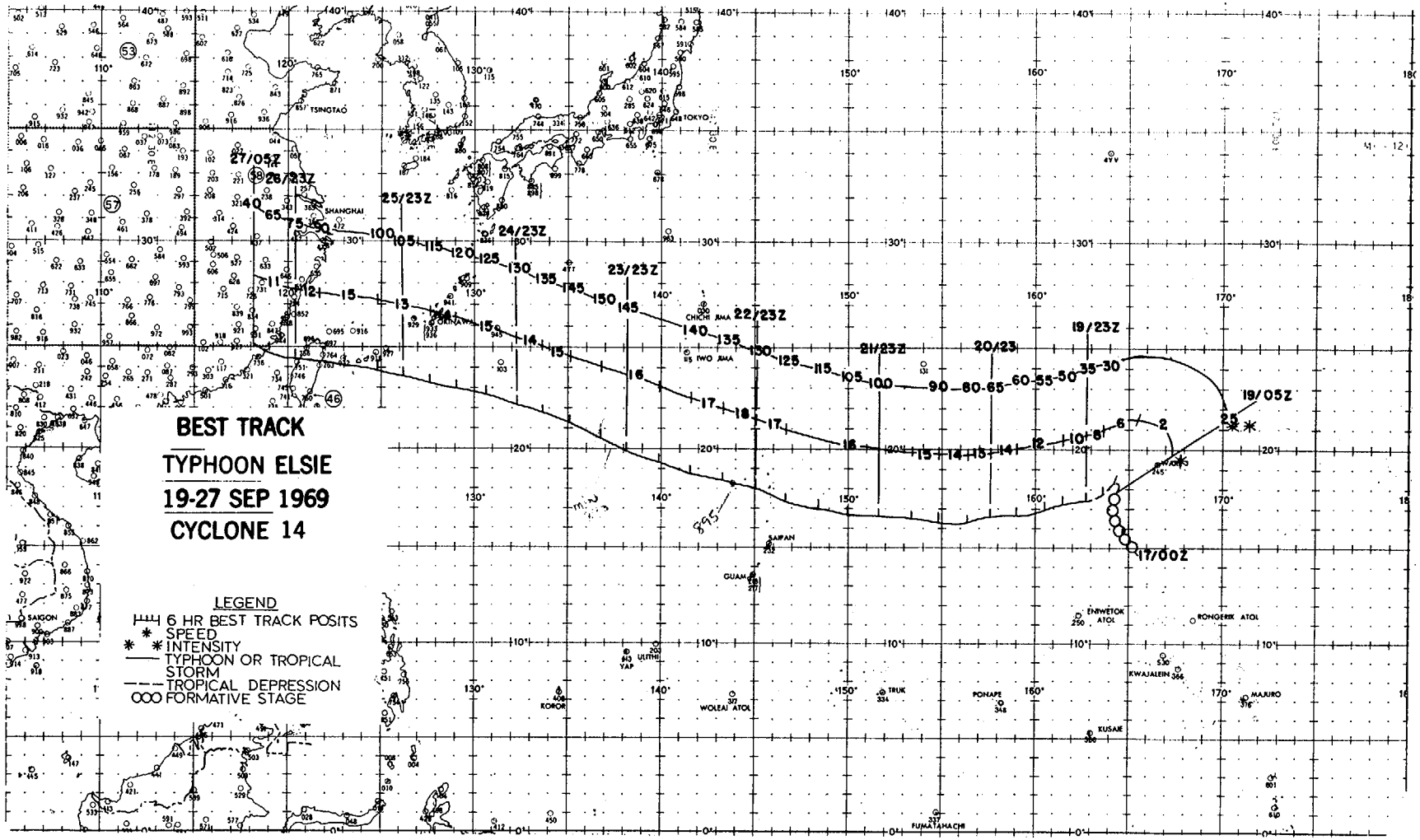
A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX
1. EMBEDDED VORTEX AT 170000Z
2. SURFACE PRESSURE LESS THAN 1006 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - VARIABLE
2. UPON REACHING TYPHOON INTENSITY - EAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND


BEST TRACK
TYPHOON ELSIE
19-27 SEP 1969
CYCLONE 14
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
27/05Z
26/23Z
25/23Z
24/23Z
23/23Z
22/23Z
21/23Z
20/23
19/23Z
19/05Z
17/00Z
TSINGTAO
SHANGHAI
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
SAIGON
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
FUMATAMACHI

EYE FIXES CYCLONE 14

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL T/TD	EYE FORM	ORIEN-TATION	EYE DIA	TRKNS WALL CLOUD
1	170211Z	16.0N 166.0E	SLTLS	STG 3	DIA --	BNDS -							
2	180310Z	16.0N 165.5E	SLTLS	STG 3	DIA --	BNDS -							
3	180445Z	17.2N 164.2E	54-P----25	0430M	020	015	999	---	26/24	----			F.B.
4	190358Z	17.8N 164.4E	54-P----03	0460M	032	025	998	---	26/25	----			F.B.
5	190409Z	17.0N 163.0E	SLTLS	STG C	DIA --	BNDS -							
6	192045Z	17.3N 163.4E	54-P----08	700MB	035	040	994	3011	19/14	CIRC	----	10	--
7	200230Z	17.5N 161.7E	54-P----03	700MB	052	065	984	2966	18/12	CIRC	----	05	--
8	200312Z	16.5N 162.0E	SLTLS	STG C	DIA --	BNDS -							
9	200928Z	16.9N 161.2E	VW-P----10	0320M	030	045	979	---	28/24	CIRC	----	30	10
10	201435Z	16.7N 159.7E	VW-P----05	0210M	---	065	974	---	28/25	CIRC	----	30	--
11	202130Z	16.6N 157.9E	54-P----15	700MB	070	065	971	2856	20/12	CIRC	----	10	--
12	210245Z	16.4N 156.8E	54-P----04	700MB	070	080	960	---	20/12	CIRC	----	12	--
13	210411Z	16.5N 156.5E	SLTLS	STG X	DIA 03	BNDS 2							
14	210929Z	16.3N 154.5E	VW-P----05	0990M	100	100	955	---	25/22	CIRC	----	18	12
15	211400Z	16.5N 153.9E	VW-R----07		---	---	---	---	--/--	ELIP	NE-SW	38X26	10
16	212100Z	16.4N 152.3E	54-P----05	700MB	100	100	945	2620	20/12	ELIP	NW-SE	27X20	--
17	220300Z	16.6N 150.6E	54-P----20	3010M	103	110	937	2550	15/10	CIRC	----	15	08
18	220314Z	16.5N 150.0E	SLTLS	STG X	DIA 05	BNDS 3							
19	220850Z	16.8N 149.3E	VW-R----10		---	---	---	---	--/--	----			--
20	220903Z	16.9N 149.0E	VW-R----05		---	---	---	---	--/--	CIRC	----	30	07
21	221132Z	16.9N 148.1E	VW-R----05		---	---	---	---	--/--	CIRC	----	32	--
22	221450Z	16.9N 147.2E	VW-R----05		---	---	---	---	--/--	CIRC	----	30	08
23	222100Z	18.1N 145.5E	54-P----07	700MB	150	130	903	2228	24/12	CIRC	----	25	--
24	230015Z	18.0N 144.6E	54-P----07	3100M	160	130	900	2201	26/13	CIRC	----	25	--
25	230245Z	18.2N 143.9E	54-P----07	700MB	100	130	896	3173	24/12	CIRC	----	25	05
26	230413Z	18.0N 143.0E	SLTLS	STG X	DIA 06	BNDS 3							
27	230800Z	18.6N 142.5E	VW-R----20		---	---	---	---	--/--	----			--
28	230840Z	18.4N 142.1E	VW-R----05		---	065	---	---	--/--	CIRC	----	26	06
29	231210Z	18.8N 141.3E	VW-R----10		---	---	---	---	--/--	CIRC	----	28	09
30	231442Z	19.1N 140.6E	VW-P----05	700MB	---	---	---	2246	23/12	CIRC	----	34	06
31	232115Z	19.7N 138.7E	54-P----07	700MB	105	130	896	3143	18/10	CIRC	----	25	06
32	240300Z	20.2N 137.2E	54-P----05	700MB	112	130	890	3140	20/10	CIRC	----	30	05
33	240511Z	21.0N 136.0E	SLTLS	STG X	DIA 05	BNDS 4							
34	240920Z	21.0N 135.4E	VW-R----07		---	---	---	---	--/--	CIRC	----	25	06
35	241207Z	21.4N 134.8E	VW-R----07		---	---	---	---	--/--	CIRC	----	35	--
36	241405Z	21.5N 134.5E	VW-R---- 7		---	---	---	---	--/--	CIRC	----	28	06
37	242159Z	22.1N 132.4E	54-P----02	700MB	125	130	918	2390	19/12	CIRC	----	28	08
38	250000Z	22.2N 132.1E	54-P----02	700MB	100	130	919	2390	19/12	CIRC	----	30	08
39	250215Z	22.5N 131.4E	54-P----02	700MB	125	130	921	2405	19/11	CIRC	----	30	06
40	250610Z	23.0N 130.0E	SLTLS	STG X	DIA 06	BNDS 4							
41	250840Z	22.5N 129.4E	VW-R----25		---	---	---	---	--/--	----			--
42	250930Z	22.4N 130.0E	VW-R----20		---	---	---	---	--/--	CIRC	----	31	12
43	251045Z	22.9N 129.4E	VW-P----15	700MB	---	---	918	2484	21/13	CIRC	----	32	10
44	251130Z	23.1N 129.0E	VW-R----20		---	---	---	---	--/--	CIRC	----	35	--
45	251141Z	22.9N 129.0E	VW-R----05		---	---	---	---	--/--	CIRC	----	44	--
46	251455Z	22.9N 128.4E	VW-R----05		---	---	---	---	--/--	CIRC	----	28	05
47	252045Z	23.4N 126.9E	54-P----10	700MB	105	---	950	2649	20/10	CIRC	----	30	--
48	252340Z	23.3N 126.0E	54-P----08	700MB	075	100	934	2365	20/14	CIRC	----	32	--

EYE FIXES CYCLONE 14

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL TT/TD	EYE FORM	ORIEN-TATION	EYE DIA	THRDS WALL CLOUD
49	260100Z	23.6N 125.6E	LND RDR		---	---	---	---[92]	--/--	----			--
50	260200Z	23.6N 125.6E	54-P----08	700MB	095	100	923	2426	19/14	CIRC	----	30	--
51	260400Z	23.5N 125.0E	LND RDR		---	---	---	---	--/--	----			--
52	260514Z	23.5N 124.0E	SLTLS	STG X	DIA 06	BNDS 4							
53	260515Z	23.7N 124.3E	LND RDR		---	---	---	---	--/--	----			--
54	260600Z	23.6N 124.5E	LND RDR		---	---	---	---	--/--	----			--
55	260800Z	23.7N 124.2E	LND RDR		---	---	---	---	--/--	----			--
56	260800Z	23.8N 124.1E	LND RDR		---	---	---	---	--/--	----			--
57	260805Z	23.9N 124.2E	VW-R----05		---	085	---	---	--/--	CIRC	----	35	--
58	260930Z	23.9N 123.5E	LND RDR		---	---	---	---	--/--	----			--
59	261140Z	23.9N 123.2E	VW-R----05		---	---	---	---	--/--	ELIP	NE-SW	45X25	--
60	261248Z	24.0N 122.8E	VW-R------		---	---	---	---	--/--	CIRC	----	40	--
61	261340Z	24.2N 122.8E	LND RDR		---	---	---	---	--/--	----			--
62	261457Z	24.0N 122.2E	VW-R----03		---	055	---	---	--/--	CIRC	----	20	15
63	261800Z	24.0N 120.7E	LND RDR		---	---	---	---	--/--	----			--
64	261830Z	23.8N 120.5E	LND RDR		---	---	---	---	--/--	----			--
65	261900Z	23.7N 119.8E	LND RDR		---	---	---	---	--/--	----			--
66	262000Z	23.7N 120.3E	LND RDR		---	---	---	---	--/--	----			--
67	262100Z	23.6N 120.3E	LND RDR		---	---	---	---	--/--	----			--
68	262110Z	24.0N 120.2E	54-P----30	729MB	035	---	---	---	59/59	----			--
69	270530Z	24.5N 119.1E	LND RDR		---	---	---	---	--/--	----			--

TYPHOON ELSIE

TROPICAL CYCLONE 14 -- 09/19/1100Z TO 09/19/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
04	192300Z	17.5N	163.3E	17.4N	162.7E	18.2N	161.8E	--------	-	-	--------	-	-	--------
05	200500Z	17.7N	161.4E	17.3N	161.5E	19.3N	159.8E	--------	20.9N	159.5E	--------	22.9N	159.7E	
06	201100Z	16.9N	161.5E	16.8N	160.4E	18.0N	161.0E	051-0222	18.8N	160.1E	--------	-	-	--------
07	201700Z	16.7N	159.2E	16.7N	159.0E	16.5N	155.0E	059-0264	16.4N	150.9E	--------	16.5N	146.7E	--------
08	202300Z	16.6N	157.5E	16.6N	157.6E	16.5N	151.3E	069-0258	16.8N	145.9E	--------	-	-	--------
09	210500Z	16.4N	156.3E	16.3N	156.3E	16.4N	150.5E	048-0264	16.8N	145.8E	--------	16.9N	140.1E	--------
10	211100Z	16.2N	154.1E	16.3N	154.9E	16.7N	147.6E	074-0360	16.9N	141.5E	--------	-	-	--------
11	211700Z	16.4N	153.0E	16.5N	153.3E	16.7N	146.6E	090-0096	16.5N	140.4E	--------	16.2N	133.8E	--------
12	212300Z	16.5N	151.8E	16.5N	151.7E	16.7N	146.4E	270-0018	16.5N	140.8E	--------	-	-	--------
13	220500Z	16.6N	150.1E	16.7N	150.0E	16.8N	144.2E	126-0030	17.5N	138.4E	065-0594	18.9N	133.1E	--------
14	221100Z	16.9N	148.4E	16.9N	148.4E	17.8N	142.2E	255-0042	18.7N	136.0E	081-0672	-	-	--------
15	221700Z	17.1N	146.7E	17.3N	146.7E	17.9N	139.9E	180-0036	19.0N	133.2E	102-0246	20.0N	126.6E	--------
16	222300Z	18.1N	144.9E	18.0N	145.1E	20.5N	138.1E	137-0102	23.8N	132.8E	149-0078	-	-	--------
17	230500Z	18.3N	143.4E	18.3N	143.2E	19.5N	137.1E	149-0102	20.4N	130.9E	122-0168	21.4N	124.5E	074-0966
18	231100Z	18.6N	141.5E	18.7N	141.5E	19.6N	134.9E	146-0060	20.5N	128.2E	180-0108	-	-	--------
19	231700Z	19.3N	140.0E	19.3N	139.9E	20.9N	133.7E	180-0084	22.6N	127.2E	171-0168	24.2N	120.8E	113-0414
20	232300Z	19.8N	138.1E	19.8N	138.2E	21.0N	131.2E	360-0042	21.6N	124.4E	143-0240	-	-	--------
21	240500Z	20.3N	136.6E	20.4N	136.7E	21.6N	130.0E	161-0054	22.0N	123.2E	151-0198	22.0N	116.3E	137-0282
22	241100Z	21.1N	135.0E	21.1N	135.1E	23.1N	128.2E	184-0090	23.5N	121.1E	161-0150	-	-	--------
23	241700Z	21.8N	133.8E	21.7N	133.6E	23.2N	128.5E	172-0048	23.5N	122.0E	187-0162	23.5N	115.5E	177-0330
24	242300Z	22.2N	132.1E	22.1N	132.2E	23.5N	125.8E	220-0084	23.5N	119.3E	017-0102	-	-	--------
25	250500Z	22.7N	130.8E	22.6N	130.6E	24.5N	125.8E	207-0066	25.4N	120.4E	174-0132	26.2N	115.0E	148-0258
26	251100Z	22.7N	129.6E	22.8N	129.0E	23.2N	123.7E	293-0042	23.7N	117.6E	197-0144	-	-	--------
27	251700Z	22.9N	128.0E	23.2N	127.6E	23.3N	122.4E	090-0040	23.7N	116.7E	207-0036	-	-	196-0198
28	252300Z	23.4N	126.3E	23.5N	126.2E	24.2N	120.2E	270-0018	24.9N	114.8E	221-0144	-	-	--------
29	260500Z	23.7N	124.8E	23.8N	124.8E	24.6N	118.8E	053-0066	25.5N	113.5E	218-0132	-	-	185-0144
30	261100Z	23.9N	123.5E	24.1N	123.2E	24.8N	117.6E	156-0054	25.5N	113.3E	253-0114	-	-	--------
31	261700Z	24.2N	121.8E	24.3N	121.5E	25.0N	116.5E	141-0072	25.6N	112.2E	153-0048	-	-	261-0036
32	262300Z	24.4N	119.7E	24.3N	120.3E	25.1N	114.5E	180-0006	-	-	229-0072	-	-	--------
33	270500Z	24.5N	119.4E	24.6N	119.1E	25.4N	117.4E	270-0012	27.5N	116.1E	054-0078	-	-	224-0216
34	271100Z	24.8N	118.1E	25.2N	118.1E	-	-	226-0030	-	-	195-0090	-	-	--------

AVERAGE 24 HOUR ERROR - 0092 MI.
AVERAGE 48 HOUR ERROR - 0176 MI.
AVERAGE 72 HOUR ERROR - 0316 MI.

TYPHOON GRACE - 09/29/2300Z TO 10/06/2300Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 29
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 21
3. DISTANCE TRAVELED DURING WARNING PERIOD - 2172 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 937 MBS AT 032130Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2548 M AT 032130Z
3. MAXIMUM SURFACE WIND - 095 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 300 MI

II. DEVELOPMENT

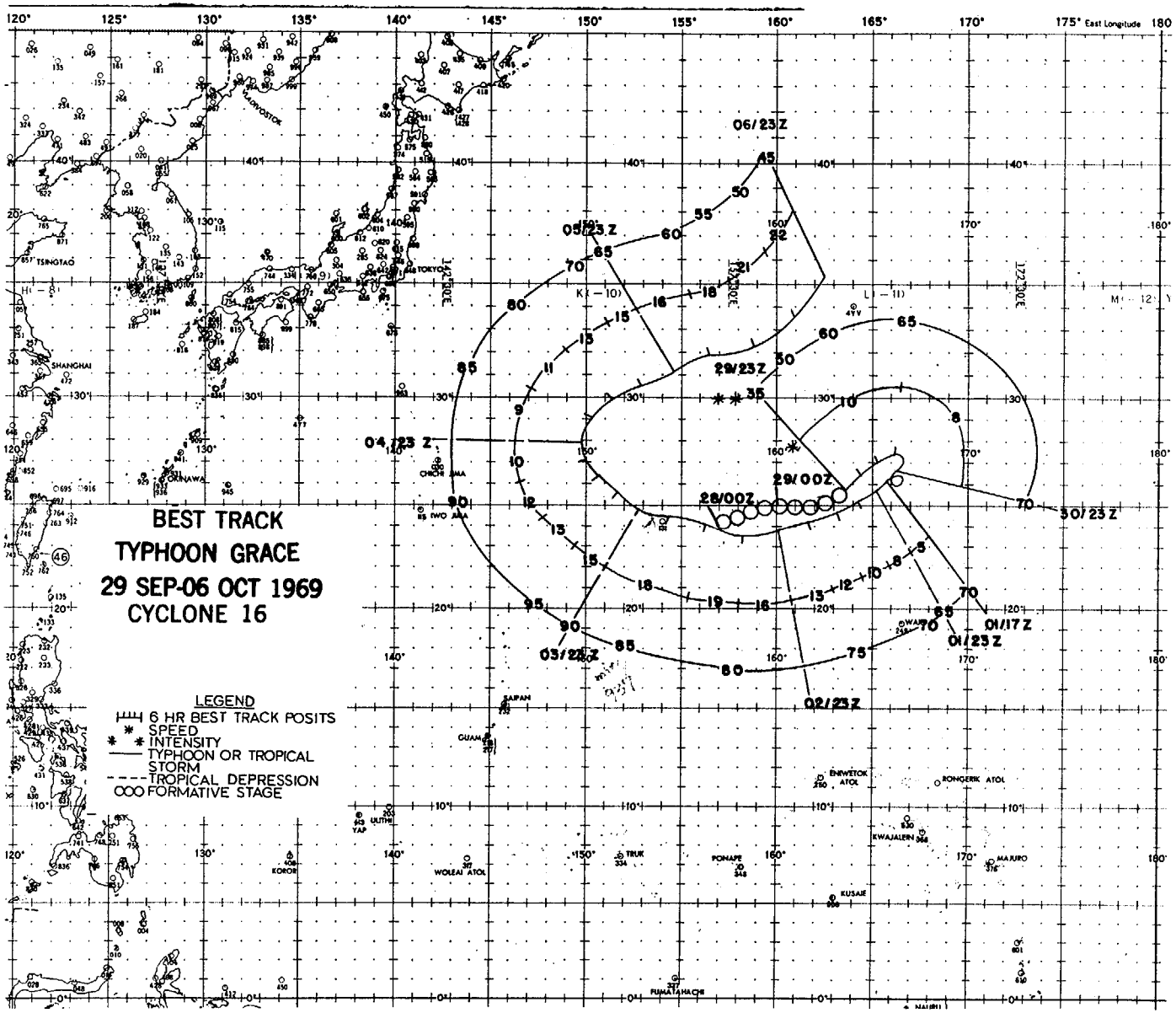
A. INITIAL IMPETUS - A COLD CORE LOW BECOMING WARM CORE AFTER DEVELOPMENT OF DIVERGENCE AT 200 MB

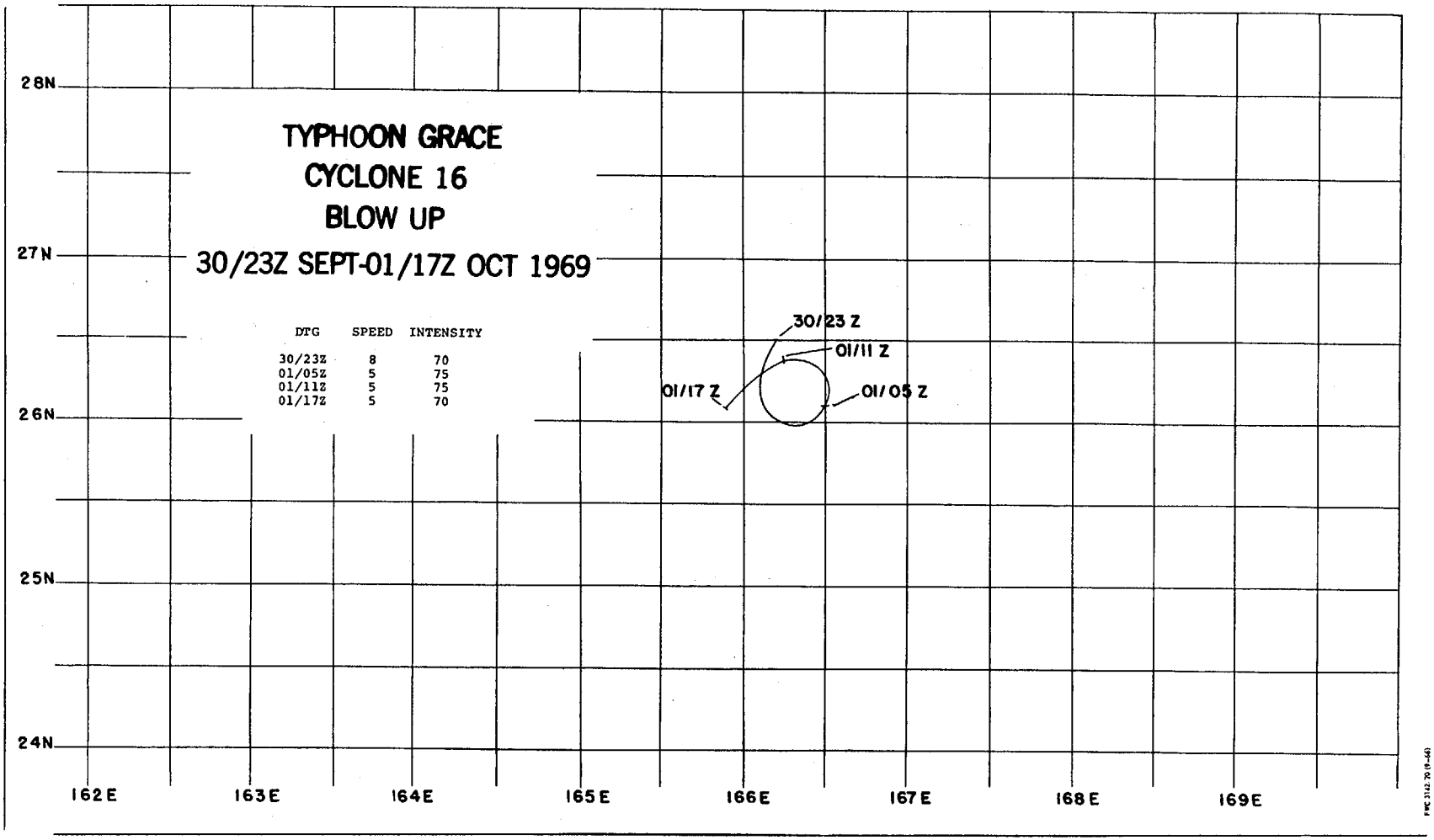
B. INITIAL SURFACE VORTEX
1. COLD VORTEX AT 280000Z
2. SURFACE PRESSURE LESS THAN 1012 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - VARIABLE
2. UPON REACHING TYPHOON INTENSITY - ANTICYCLONIC

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL


BEST TRACK
TYPHOON GRACE
29 SEP-06 OCT 1969
CYCLONE 16
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
06/23Z
05/23Z
04/23Z
03/23Z
02/23Z
01/23Z
01/17Z
30/23Z
29/23Z
29/00Z
28/00Z
SHANGHAI
TSINGTAO
TOKYO
OKINAWA
IWO JIMA
GUAM
SAIPAN
TRUK
PONAPE
KOROR
WOLEAI ATOL
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
FUNAFUTI


TYPHOON GRACE
CYCLONE 16
BLOW UP
30/23Z SEPT-01/17Z OCT 1969
DTG SPEED INTENSITY
30/23Z 8 70
01/05Z 5 75
01/11Z 5 75
01/17Z 5 70
30/23 Z
01/11 Z
01/17 Z
01/05 Z
28N
27N
26N
25N
24N
162E
163E
164E
165E
166E
167E
168E
169E

EYE FIXES CYCLONE 16

FIX NO.	TIME	POSIT	UNIT-METHOD -ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LV. TT/TD	EYE FORM	ORIEN-TATION	EYE DIA	THKNS WALL CLOUD
1	170211Z	14.0N 181.0E	SLTLS	STG B	DIA --	BNDS -							
2	170211Z	14.0N 181.0E	SLTLS	STG B	DIA --	BNDS -							
3	180105Z	14.2N 177.8E	54-P----10	0450M	042	030	998	---	26/24	----			N.F.B.
4	180310Z	14.0N 178.0E	SLTLS	STG C	DIA --	BNDS -							
5	190015Z	13.8N 175.8E	54-P----25	0430M	042	015	004	---	25/24	----			N.F.B.
6	220314Z	15.0N 169.0E	SLTLS	STG B	DIA --	BNDS -							
7	230217Z	16.0N 169.0E	SLTLS	STG C	DIA --	BNDS -							
8	240316Z	18.0N 165.0E	SLTLS	STG B	DIA --	BNDS -							
9	250415Z	20.0N 160.5E	SLTLS	STG C	DIA --	BNDS -							
10	260318Z	20.0N 155.0E	SLTLS	STG B	DIA --	BNDS -							
11	270220Z	25.0N 160.0E	SLTLS	STG B	DIA --	BNDS -							
12	280320Z	25.0N 161.0E	SLTLS	STG B	DIA --	BNDS -							
13	290228Z	24.0N 163.0E	SLTLS	STG B	DIA --	BNDS -							
14	300322Z	26.0N 164.0E	SLTLS	STG X	DIA 02	BNDS 3		962					
15	302129Z	26.6N 166.3E	54-P----25	700MB	090	070	971	2756	18/12	ELIP	N-S	15X10	--
16	010226Z	27.0N 166.5E	SLTLS	STG X	DIA 03	BNDS 3							
17	010245Z	26.2N 166.4E	54-P----25	700MB	090	080	953	2704	16/10	CIRC	----	12	--
18	010800Z	26.3N 166.3E	VW-R----15		---	---	---	---	--/--	----			--
19	010830Z	26.4N 166.6E	VW-R----10		---	---	---	---	--/--	CIRC	----	18	13
20	012100Z	25.9N 165.7E	54-P----20	700MB	075	070	967	2813	22/14	CIRC	----	20	--
21	020255Z	25.4N 164.7E	54-P----15	700MB	095	090	965	2801	21/12	CIRC	----	15	--
22	020325Z	25.5N 164.5E	SLTLS	STG -	DIA --	BNDS -							
23	021000Z	24.5N 163.2E	VW-R----20		---	---	---	---	--/--	----			--
24	021200Z	24.5N 162.6E	VW-P----05	700MB	080	---	958	2838	20/14	CIRC	----	25	--
25	022005Z	24.1N 160.9E	54-P----10	700MB	071	080	958	2749	20/12	CIRC	----	15	--
26	030245Z	23.4N 158.7E	54-P----25	700MB	080	085	952	2731	26/16	CIRC	----	15	10
27	030423Z	24.0N 158.0E	SLTLS	STG -	DIA --	BNDS -							
28	030900Z	24.1N 156.3E	VW-R----07		---	---	---	---	--/--	CIRC	----	15	10
29	031200Z	24.4N 155.4E	VW-R----10		---	---	---	---	--/--	CIRC	----	17	12
30	031400Z	24.7N 154.2E	VW-R----05		---	---	---	938 ---	--/--	CIRC	----	17	12
31	032130Z	24.4N 153.2E	54-P----08	700MB	085	090	937	2548	16/09	CIRC	----	20	--
32	040254Z	25.2N 152.2E	54-P----10	700MB	092	100	945	2624	24/16	CIRC	----	30	04
33	040327Z	25.5N 152.0E	SLTLS	STG X	DIA 03	BNDS 4							
34	040900Z	26.2N 150.9E	VW-R----05		---	---	---	---	--/--	----			12
35	041455Z	26.3N 150.6E	VW-R----05		---	---	---	---	--/--	CIRC	----	20	12
36	042100Z	27.6N 149.9E	54-P----12	700MB	090	085	940	2600	20/14	CIRC	----	15	--
37	050205Z	28.5N 149.9E	54-P----20	700MB	095	085	944	2621	16/12	CIRC	----	15	--
38	050426Z	29.0N 150.5E	SLTLS	STG X	DIA 03	BNDS 3							
39	051000Z	29.9N 151.1E	VW-R----05		050	035	---	---	--/--	ELIP	NW-SE	15X13	--
40	051400Z	30.2N 152.2E	VW-R----05		050	---	---	---	--/--	ELIP	NW-SE	15X12	--
41	052100Z	30.7N 153.9E	54-P----05	700MB	040	090	967	2752	21/14	CIRC	----	20	F.B.
42	060100Z	31.6N 155.2E	54-P----05	700MB	060	070	965	2819	23/13	CIRC	----	25	F.B.
43	060333Z	31.0N 156.0E	SLTLS	STG X	DIA 03	BNDS 4							
44	060930Z	31.7N 158.6E	VW-R----10		---	---	---	---	--/--	----			--
45	061000Z	32.5N 159.2E	VW-R----05		---	---	---	---	--/--	----			--
46	061230Z	32.4N 159.8E	VW-R----05		---	---	---	---	--/--	----			F.B.
47	062105Z	34.5N 161.9E	54-P----10	700MB	040	050	998	3011	08/10	CIRC	----	15	N.F.B.

TYPHOON GRACE

TROPICAL CYCLONE 16 -- 09/29/2300Z TO 10/06/2300Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
01	292300Z	26.7N	165.4E	25.7N	163.6E	28.8N	170.3E	---------	-	-	--------	-	-	--------
02	300500Z	27.2N	166.6E	26.4N	164.4E	29.4N	171.6E	--------	-	-	--------	-	-	--------
03	301100Z	27.4N	167.0E	27.0N	165.3E	29.2N	171.0E	--------	-	-	--------	-	-	--------
04	301700Z	27.9N	168.0E	27.3N	166.2E	29.6N	172.0E	--------	-	-	--------	-	-	--------
05	302300Z	26.9N	166.6E	26.5N	166.2E	29.2N	170.2E	058-0252	32.8N	174.4E	--------	-	-	--------
06	010500Z	26.2N	166.4E	26.1N	166.5E	26.2N	166.4E	054-0330	27.6N	167.2E	--------	-	-	--------
07	011100Z	26.4N	166.6E	26.4N	166.3E	26.4N	166.6E	056-0294	27.2N	167.4E	--------	-	-	--------
08	011700Z	26.4N	166.6E	26.1N	165.9E	26.4N	166.6E	058-0384	27.2N	167.4E	--------	28.0N	168.2E	--------
09	012300Z	25.9N	165.7E	25.7N	165.2E	25.9N	165.7E	052-0336	25.9N	165.7E	--------	-	-	--------
10	020500Z	25.3N	164.4E	25.2N	164.2E	24.3N	161.2E	063-0126	23.7N	157.8E	--------	23.4N	154.3E	--------
11	021100Z	24.7N	162.8E	24.7N	163.1E	23.3N	157.2E	062-0210	23.4N	150.9E	--------	-	-	--------
12	021700Z	24.3N	161.6E	24.2N	161.8E	23.2N	156.1E	063-0288	23.5N	150.3E	--------	25.3N	144.8E	--------
13	022300Z	23.9N	160.2E	23.7N	160.1E	23.1N	154.4E	067-0330	23.9N	148.3E	055-0936	-	-	--------
14	030500Z	23.3N	158.0E	23.4N	158.1E	23.3N	150.6E	073-0174	24.5N	145.4E	063-0552	27.1N	141.3E	--------
15	031100Z	24.0N	155.7E	24.1N	156.2E	24.2N	147.8E	131-0072	27.5N	142.5E	073-0630	-	-	--------
16	031700Z	24.8N	153.1E	24.5N	154.4E	25.3N	145.3E	130-0114	29.2N	142.0E	078-0720	33.0N	144.1E	--------
17	032300Z	24.6N	152.7E	24.7N	152.7E	25.9N	147.4E	184-0090	28.6N	145.1E	085-0708	-	-	--------
18	040500Z	25.3N	151.7E	25.5N	151.6E	29.3N	149.2E	203-0138	33.9N	153.5E	107-0348	39.8N	163.1E	--------
19	041100Z	26.4N	150.5E	26.3N	150.6E	30.9N	150.6E	230-0192	35.0N	156.0E	176-0174	-	-	--------
20	041700Z	26.5N	150.6E	27.1N	150.0E	29.7N	151.0E	247-0270	34.3N	156.1E	176-0216	40.0N	166.0E	087-0972
21	042300Z	27.9N	150.0E	27.9N	149.8E	31.8N	153.0E	227-0174	35.8N	158.8E	221-0264	-	-	--------
22	050500Z	29.1N	149.8E	29.0N	150.2E	33.7N	153.2E	290-0048	37.3N	161.9E	224-0372	41.9N	172.2E	147-0396
23	051100Z	30.2N	151.2E	29.9N	151.3E	34.2N	156.7E	329-0066	38.4N	164.9E	253-0480	-	-	--------
24	051700Z	30.7N	152.8E	30.4N	152.9E	34.3N	159.0E	247-0102	38.9N	166.9E	263-0570	42.0N	178.0E	235-0528
25	052300Z	30.9N	154.4E	31.1N	154.5E	33.4N	161.3E	300-0078	38.0N	169.3E	254-0510	-	-	--------
26	060500Z	31.9N	156.4E	31.8N	156.4E	36.6N	167.3E	305-0198	-	-	311-0186	-	-	251-0834
27	061100Z	32.7N	159.6E	32.2N	158.9E	38.9N	172.4E	318-0156	-	-	319-0216	-	-	--------
28	061700Z	33.1N	161.8E	33.5N	161.0E	-	-	296-0102	-	-	281-0246	-	-	270-0846
29	062300Z	35.0N	162.5E	35.3N	162.5E	-	-	206-0126	-	-	279-0180	-	-	--------

AVERAGE 24 HOUR ERROR - 0186 MI.
AVERAGE 48 HOUR ERROR - 0429 MI.
AVERAGE 72 HOUR ERROR - 0715 MI.

TYPHOON HELEN - 10/08/0500Z TO 10/12/2300Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 20
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 10
3. DISTANCE TRAVELED DURING WARNING PERIOD - 2340 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 930 MBS AT 110300Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2481 M AT 110300Z
3. MAXIMUM SURFACE WIND - 105 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 330 MI

II. DEVELOPMENT

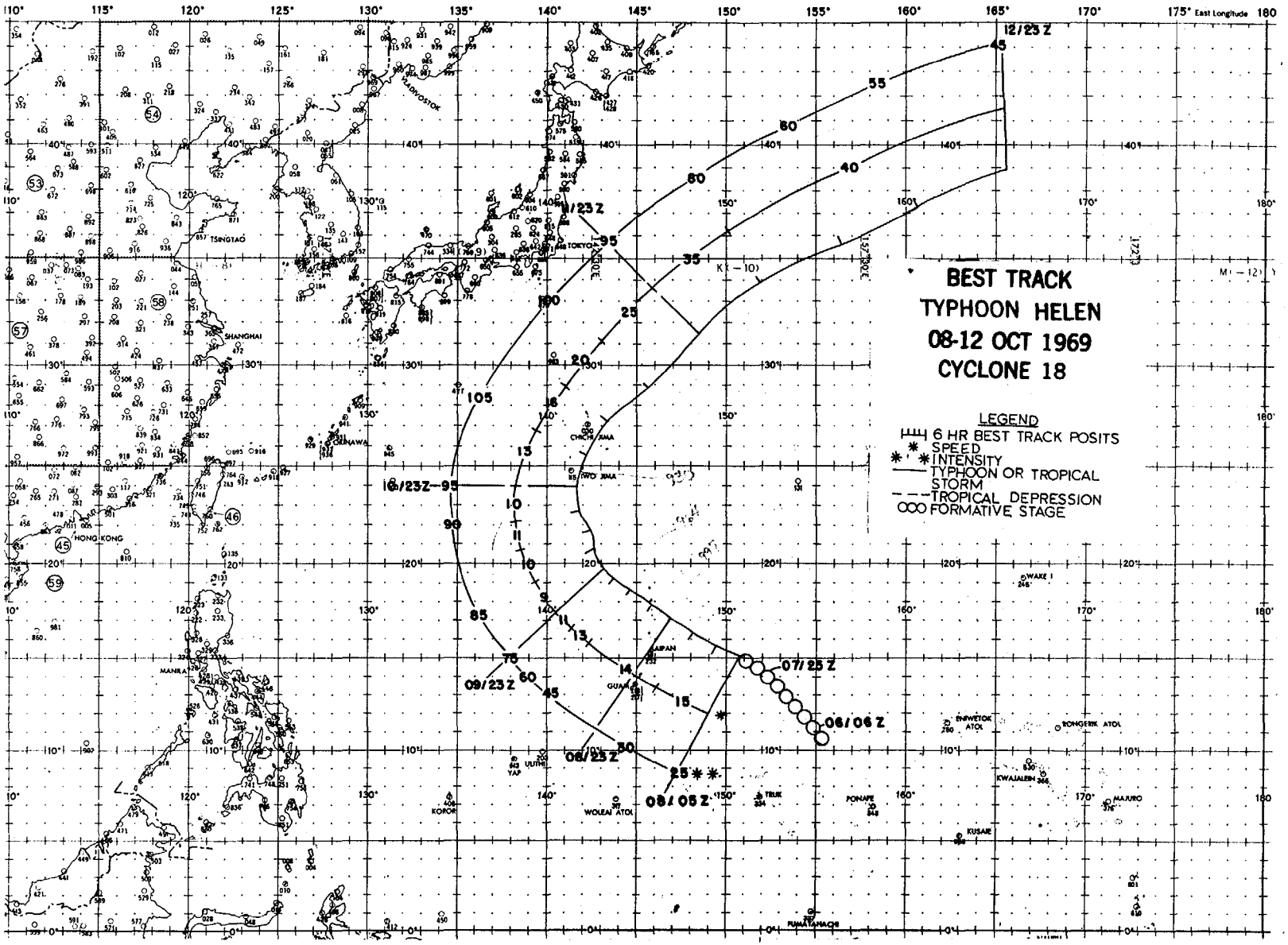
A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX
1. JUNCTION VORTEX AT 060600Z
2. SURFACE PRESSURE LESS THAN 1007 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - ANTICYCLONIC
2. UPON REACHING TYPHOON INTENSITY - EAST

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL


BEST TRACK
TYPHOON HELEN
08-12 OCT 1969
CYCLONE 18
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
12/23 Z
10/23Z-95
09/23 Z
08/23 Z
08/05 Z
07/23 Z
06/06 Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
TOKYO
NAHA
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
GUAM
SAIPAN
YAP
ULITHI
KOROR
WOLEAI ATOLL
TRUK
PONAPE
KUSAIE
KWAJALEIN
MAJURO
ENIWETOK ATOL
RONGERIK ATOL
WAKE I
PUNTA ARENAS

EYE FIXES CYCLONE 18

FIX NO.	TIME	POSITION	METHOD -ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL TT/TD	EYE FORM	ORIENTATION	EYE DIA	EYEWALL CLOUD
1	070423Z	09.0N 150.0E	SLTLS	STG A	DIA -- BNDS -								
2	080216Z	14.5N 151.7E	54-P----10	0470M	030	025	004	---	26/24	CIRC	----	15	10
3	080331Z	15.0N 150.0E	SLTLS	STG 8	DIA -- BNDS -								
4	080925Z	15.5N 149.5E	VW-P----05	0450M	---	020	003	---	26/22	----			F.R.
5	081215Z	15.5N 149.1E	VW-R-----		---	---	---	---	--/--	----			--
6	081510Z	16.0N 148.5E	VW-P----05	0450M	---	030	997	---	24/22	----			F.R.
7	082125Z	16.9N 147.3E	54-P----10	700MB	035	030	000	3072	14/12	----			F.R.
8	090300Z	17.7N 146.2E	54-P----05	700MB	045	040	997	3048	13/10	----			F.R.
9	090430Z	17.5N 146.0E	SLTLS	STG X	DIA 04 BNDS 2								
10	090802Z	19.4N 144.9E	VW-R----10		---	---	---	---	--/--	----			--
11	090910Z	18.4N 145.2E	VW-R----10		---	035	---	---	--/--	CIRC	----	22	F.R.
12	091205Z	18.8N 144.5E	VW-R----05		---	---	---	---	--/--	CIRC	----	18	--
13	091404Z	18.6N 144.2E	VW-R----10		---	---	---	---	--/--	CIRC	----	15	05
14	092045Z	19.6N 143.4E	54-P----10	700MB	060	075	964	2774	17/10	CIRC	----	14	03
15	100230Z	20.1N 142.7E	54-P----12	700MB	090	120	---	2713	18/10	CIRC	----	10	05
16	100529Z	20.5N 142.0E	SLTLS	STG X	DIA 03 BNDS 3								
17	100903Z	21.5N 142.4E	VW-R----03	700MB	---	---	---	---	--/--	CIRC	----	10	--
18	101158Z	21.8N 142.2E	VW-R----05		---	---	---	---	--/--	CIRC	----	12	07
19	101405Z	22.2N 141.1E	VW-R----03		---	---	---	---	--/--	CIRC	----	14	--
20	101405Z	22.2N 141.1E	VW-R----03		---	---	---	---	--/--	CIRC	----	14	--
21	110300Z	25.0N 141.9E	54-P----05	700MB	125	110	930	2481	20/14	CIRC	----	20	--
22	110432Z	25.0N 142.0E	SLTLS	STG X	DIA 03 BNDS 4								
23	111056Z	26.6N 144.5E	VW-R----10		---	---	---	---	--/--	CIRC	----	18	--
24	111356Z	27.1N 142.5E	VW-R----10		---	---	---	---	--/--	CIRC	----	15	--
25	111445Z	28.2N 144.6E	VW-R----10		---	---	---	---	--/--	CIRC	----	15	--
26	112110Z	30.8N 147.7E	54-P----05	700MB	115	115	944	2624	24/15	CIRC	----	20	05
27	120000Z	32.0N 148.8E	54-P----05	3000M	120	100	951	2649	16/08	CIRC	----	20	--
28	120218Z	33.0N 150.0E	54-P----10	700MB	110	090	952	2704	28/22	CIRC	----	25	--
29	120339Z	33.5N 151.0E	SLTLS	STG X	DIA 03 BNDS 3								
30	121515Z	36.7N 159.2E	VW-R----05		---	---	---	---	--/--	CIRC	----	08	--

TYPHOON HELEN

TROPICAL CYCLONE 18 -- 10/08/0500Z TO 10/12/2300Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
06	091100Z	18.8N	144.9E	18.6N	144.7E	22.9N	143.0E	259-0060	27.5N	144.1E	--------	-	-	--------
07	091700Z	19.0N	144.0E	19.2N	143.8E	22.9N	142.2E	180-0048	27.1N	143.2E	--------	31.8N	147.6E	--------
08	092300Z	19.9N	143.2E	19.7N	143.1E	23.0N	141.4E	009-0084	27.1N	143.2E	--------	-	-	--------
09	100500Z	20.4N	142.4E	20.6N	142.5E	23.7N	141.5E	015-0120	27.4N	144.0E	--------	31.9N	149.3E	--------
10	101100Z	21.8N	142.1E	21.7N	142.2E	25.8N	143.3E	031-0078	29.8N	147.3E	--------	-	-	--------
11	101700Z	22.7N	142.1E	22.6N	141.8E	26.5N	143.9E	046-0020	30.2N	147.9E	--------	34.8N	154.5E	--------
12	102300Z	23.7N	141.7E	23.9N	141.7E	27.4N	144.1E	193-0050	31.7N	149.5E	--------	-	-	--------
13	110500Z	25.6N	142.3E	25.5N	142.1E	34.0N	149.0E	196-0108	-	-	038-0162	-	-	--------
14	111100Z	27.2N	143.5E	27.2N	143.3E	35.8N	152.4E	180-0084	-	-	067-0042	-	-	--------
15	111700Z	28.8N	145.2E	28.8N	145.5E	37.2N	154.8E	212-0156	-	-	230-0156	-	-	--------
16	112300Z	31.6N	148.6E	31.4N	148.3E	-	-	222-0318	-	-	226-0366	-	-	--------
17	120500Z	34.3N	151.5E	33.9N	151.9E	-	-	272-0144	-	-	227-0564	-	-	280-0126
18	121100Z	36.7N	155.1E	35.6N	156.3E	-	-	273-0186	-	-	233-0570	-	-	--------
19	121700Z	37.2N	160.6E	37.3N	160.5E	-	-	269-0270	-	-	236-0756	-	-	243-0714
20	122300Z	38.5N	165.4E	38.9N	165.4E	-	-	--------	-	-	242-0894	-	-	--------

AVERAGE 24 HOUR ERROR - 0123 MI.
AVERAGE 48 HOUR ERROR - 0438 MI.
AVERAGE 72 HOUR ERROR - 0420 MI.

TYPHOON IDA - 10/15/2300Z TO 10/22/0500Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 26
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 17
3. DISTANCE TRAVELED DURING WARNING PERIOS - 1296 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 917 MBS AT 172050Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2384 M AT 172050Z
3. MAXIMUM SURFACE WIND - 115 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 360 MI

II. DEVELOPMENT

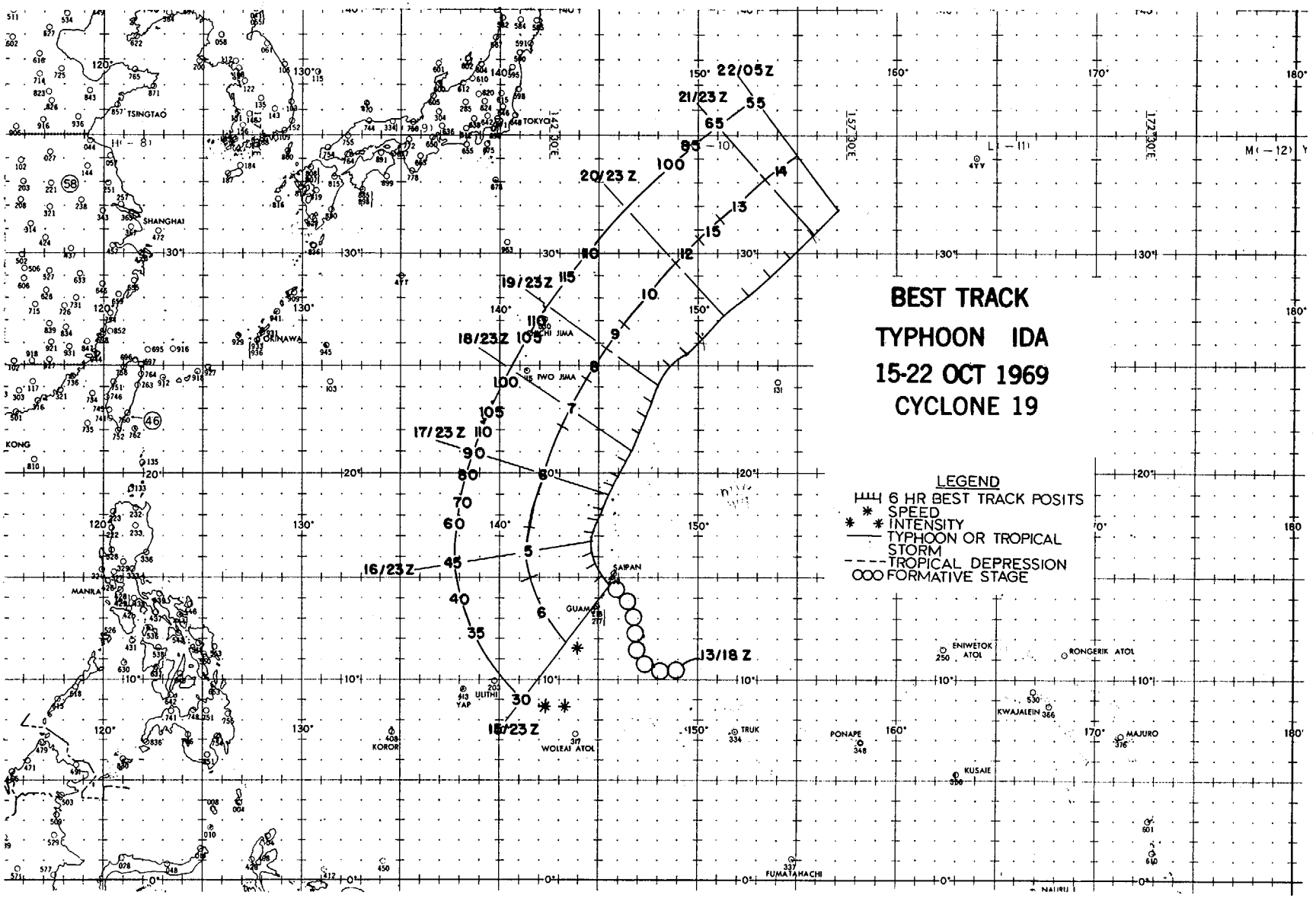
A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX
1. JUNCTION VORTEX AT 131800Z
2. SURFACE PRESSURE LESS THAN 1008 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - SOUTHWEST
2. UPON REACHING TYPHOON INTENSITY - SOUTHWEST

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL


BEST TRACK
TYPHOON IDA
15-22 OCT 1969
CYCLONE 19
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
22/05Z
21/23Z
20/23Z
19/23Z
18/23Z
17/23Z
16/23Z
15/23Z
13/18Z
TOKYO
SHANGHAI
TSINGTAO
OKINAWA
IWO JIMA
SAIPAN
GUAM
MANILA
YAP
ULITHI
WOLEAI ATOL
KOROR
TRUK
PONAPE
KUSAIE
KWAJALEIN
MAJURO
ENIWETOK ATOL
RONGERIK ATOL
FUMATAHACHI
142.5°E
157.5°E
172.5°E

EYE FIXES CYCLONE 19

FIX NO.	TIME	POSITION	UNIT-METHOD -ACCY	FLT LVL	FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL T°/TD	EYE FORM	ORIEN-TATION	EYE DIA	TRANS WALL CLOUD
1	140337Z	13.0N 152.0E	SLTLS	STG A	DIA --		BNDS -						
2	150436Z	14.0N 148.0E	SLTLS	STG A	DIA --		BNDS -						
3	152330Z	14.7N 145.6E	LND RDR		---	---	---	---	--/--	----			--
4	160010Z	14.9N 145.6E	LND RDR		---	---	---	---	--/--	----			--
5	160025Z	14.8N 145.6E	LND RDR		---	---	---	---	--/--	CIRC	----	15	--
6	160040Z	14.8N 145.4E	LND RDR		---	---	---	---	--/--	----			--
7	160050Z	14.7N 145.4E	54-P----04	0300M	055	035	005	---	21/25	----			F.B.
8	160230Z	14.9N 145.5E	54-P----04	0390M	058	030	002	---	21/26	----			F.B.
9	160340Z	13.5N 144.0E	SLTLS	STG B	DIA --		BNDS -						
10	160505Z	15.2N 145.4E	LND RDR		---	---	---	---	--/--	----			--
11	160625Z	14.8N 144.9E	VW-R-----		---	---	---	---	--/--	----			--
12	160915Z	15.9N 145.2E	LND RDR		---	---	---	---	--/--	----			--
13	161015Z	15.8N 144.9E	LND RDR		---	---	---	---	--/--	----			--
14	161045Z	15.5N 145.0E	VW-R----05		---	---	---	---	--/--	----			--
15	161140Z	15.8N 145.0E	VW-P----05	0300M	---	035	995	---	21/27	CIRC	----	16	16
16	161505Z	16.0N 144.8E	VW-P----10	0320M	---	035	995	---	28/25	CIRC	----	18	10
17	162100Z	16.4N 144.7E	54-P----02	700MB	037	045	981	2923	16/10	CIRC	----	20	--
18	170230Z	16.9N 144.7E	54-P----02	700MB	054	065	972	2883	19/12	CIRC	----	20	--
19	170438Z	17.5N 145.0E	SLTLS	STG X	DIA 03		BNDS 2						
20	171122Z	17.8N 144.6E	VW-R----05		---	---	---	---	--/--	----			--
21	171552Z	17.7N 144.8E	VW-R----03		---	---	---	---	--/--	CIRC	----	14	10
22	171500Z	18.0N 145.0E	VW-R----05		---	---	---	---	--/--	CIRC	----	10	06
23	172050Z	18.6N 145.4E	54-P----05	700MB	085	070	917	2384	24/08	CIRC	----	10	08
24	180230Z	19.2N 145.7E	54-P----05	700MB	110	110	918	2402	24/09	CIRC	----	12	08
25	180342Z	19.0N 145.5E	SLTLS	STG X	DIA 03		BNDS 4						
26	180845Z	19.8N 145.8E	VW-R----03	0400M	060	050	---	---	--/25	CIRC	----	10	06
27	181445Z	20.2N 146.1E	VW-R----03	700MB	---	---	---	2896	--/13	CIRC	----	11	--
28	182115Z	21.0N 146.6E	54-P----05	700MB	070	050	919	2487	24/12	CIRC	----	15	05
29	190239Z	21.6N 146.8E	54-P----15	700MB	110	090	929	2475	20/12	CIRC	----	20	05
30	190440Z	22.0N 147.0E	SLTLS	STG X	DIA 04		BNDS 4						
31	190855Z	23.0N 146.2E	VW-R----10		---	---	---	---	--/--	----			--
32	190915Z	22.4N 147.0E	VW-R----05		---	---	---	---	--/--	CIRC	----	20	--
33	191200Z	22.4N 147.6E	VW-R----15		---	---	---	---	--/--	CIRC	----	20	--
34	191452Z	22.9N 147.4E	VW-P----15	700MB	070	---	---	2553	18/10	CIRC	----	30	10
35	192030Z	23.8N 148.0E	54-P----10	700MB	100	140	931	2499	18/12	CIRC	----	25	07
36	192345Z	24.3N 148.2E	54-P----15	700MB	120	140	932	2487	19/08	CIRC	----	25	05
37	200245Z	24.9N 148.2E	54-P----25	700MB	120	140	930	2487	20/12	CIRC	----	30	08
38	200344Z	24.5N 148.0E	SLTLS	STG X	DIA 04		BNDS 4						
39	200815Z	25.2N 148.6E	VW-R----25		---	---	---	---	--/--	----			--
40	201207Z	25.4N 149.6E	VW-R----05		---	VRN	---	---	--/--	CIRC	----	40	07
41	201405Z	25.4N 150.8E	VW-R----07		---	070	---	---	--/--	CIRC	----	45	08
42	202110Z	26.7N 150.7E	54-P----10	700MB	130	130	944	2594	19/09	CIRC	----	20	10
43	210300Z	27.8N 152.2E	54-P----10	700MB	---	130	943	2618	18/12	CIRC	----	25	--
44	210352Z	27.5N 151.5E	SLTLS	STG X	DIA 05		BNDS 3						
45	211128Z	29.0N 152.5E	VW-R----25		---	---	---	---	--/--	----			--
46	211219Z	29.0N 153.8E	VW-P----10	700MB	---	050	975	2804	24/--	CIRC	----	70	F.B.
47	211415Z	28.9N 153.7E	VW-P----10		---	---	---	---	--/--	CIRC	----	70	F.B.
48	212030Z	30.2N 155.7E	54-P----15	700MB	050	060	958	2710	17/12	----			N.F.B.
49	220215Z	31.3N 156.5E	54-P----20	700MB	070	060	971	2614	--/--	----			N.F.B.
50	220350Z	31.5N 156.0E	SLTLS	STG X	DIA 05		BNDS 3						

TYPHOON IDA

TROPICAL CYCLONE 19 -- 10/15/2300Z TO 10/22/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
03	161100Z	15.7N	144.7E	15.7N	144.9E	18.3N	142.7E	--------	21.3N	141.4E	--------	-	-	--------
04	161700Z	16.2N	144.5E	16.2N	144.8E	19.0N	142.9E	--------	22.0N	141.9E	--------	25.8N	143.1E	--------
05	162300Z	16.6N	144.5E	16.6N	144.7E	18.3N	143.6E	256-0120	20.1N	142.6E	--------	-	-	--------
06	170500Z	17.2N	144.7E	17.2N	144.8E	19.7N	145.3E	219-0114	22.8N	147.9E	--------	25.7N	153.6E	--------
07	171100Z	17.8N	144.6E	17.8N	145.0E	20.3N	145.3E	283-0126	23.2N	148.3E	--------	-	-	--------
08	171700Z	18.2N	145.1E	18.3N	145.2E	20.5N	146.3E	288-0132	23.3N	149.5E	--------	25.4N	154.6E	--------
09	172300Z	18.8N	145.6E	18.8N	145.5E	21.3N	148.1E	255-0108	23.6N	151.8E	--------	-	-	--------
10	180500Z	19.4N	145.9E	19.4N	145.7E	21.9N	148.9E	314-0024	24.4N	153.7E	--------	28.0N	161.6E	--------
11	181100Z	20.1N	146.1E	19.9N	146.0E	22.8N	148.6E	303-0042	25.5N	153.4E	288-0270	-	-	--------
12	181700Z	20.5N	146.3E	20.6N	146.3E	23.0N	149.0E	180-0006	25.8N	153.8E	289-0252	31.0N	161.1E	--------
13	182300Z	21.3N	146.7E	21.2N	146.6E	24.1N	148.8E	086-0078	27.1N	152.9E	254-0228	-	-	--------
14	190500Z	21.9N	146.9E	21.9N	146.9E	24.5N	148.2E	090-0108	27.5N	150.4E	046-0072	30.6N	155.2E	--------
15	191100Z	22.6N	147.2E	22.6N	147.3E	25.5N	148.3E	081-0072	28.8N	149.7E	057-0060	-	-	--------
16	191700Z	23.1N	147.4E	23.3N	147.6E	25.6N	148.3E	104-0072	28.6N	149.5E	090-0102	32.6N	152.5E	301-0288
17	192300Z	24.2N	148.2E	24.1N	148.0E	28.2N	151.0E	090-0042	32.8N	156.2E	098-0204	-	-	--------
18	200500Z	25.3N	148.5E	25.0N	148.5E	29.7N	151.2E	202-0030	33.8N	155.7E	097-0282	-	-	082-0276
19	201100Z	25.8N	149.0E	25.5N	149.4E	28.4N	150.7E	270-0054	30.0N	152.8E	090-0216	-	-	--------
20	201700Z	25.5N	151.0E	26.2N	150.2E	26.7N	155.7E	252-0108	28.2N	160.2E	097-0192	-	-	101-0234
21	202300Z	26.9N	151.0E	27.1N	151.2E	30.0N	154.8E	354-0066	31.8N	161.1E	090-0090	-	-	--------
22	210500Z	28.2N	152.6E	28.1N	152.4E	31.1N	159.1E	327-0108	34.3N	166.8E	251-0108	-	-	090-0486
23	211100Z	29.1N	153.9E	28.9N	153.6E	31.5N	160.7E	259-0150	32.8N	169.0E	269-0204	-	-	--------
24	211700Z	29.6N	155.0E	29.7N	154.8E	31.7N	161.3E	165-0186	-	-	257-0282	-	-	077-0330
25	212300Z	30.5N	156.4E	30.7N	155.9E	-	-	233-0066	-	-	006-0126	-	-	--------
26	220500Z	31.5N	157.2E	31.8N	157.0E	-	-	112-0108	-	-	331-0132	-	-	232-0114

AVERAGE 24 HOUR ERROR - 0087 MI.
AVERAGE 48 HOUR ERROR - 0176 MI.
AVERAGE 72 HOUR ERROR - 0288 MI.

TYPHOON JUNE - 10/28/0500Z TO 11/05/0500Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 33
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 21
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1782 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 936 MBS AT 020820Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2643 M AT 021420Z
3. MAXIMUM SURFACE WIND - 105 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 500 MI

II. DEVELOPMENT

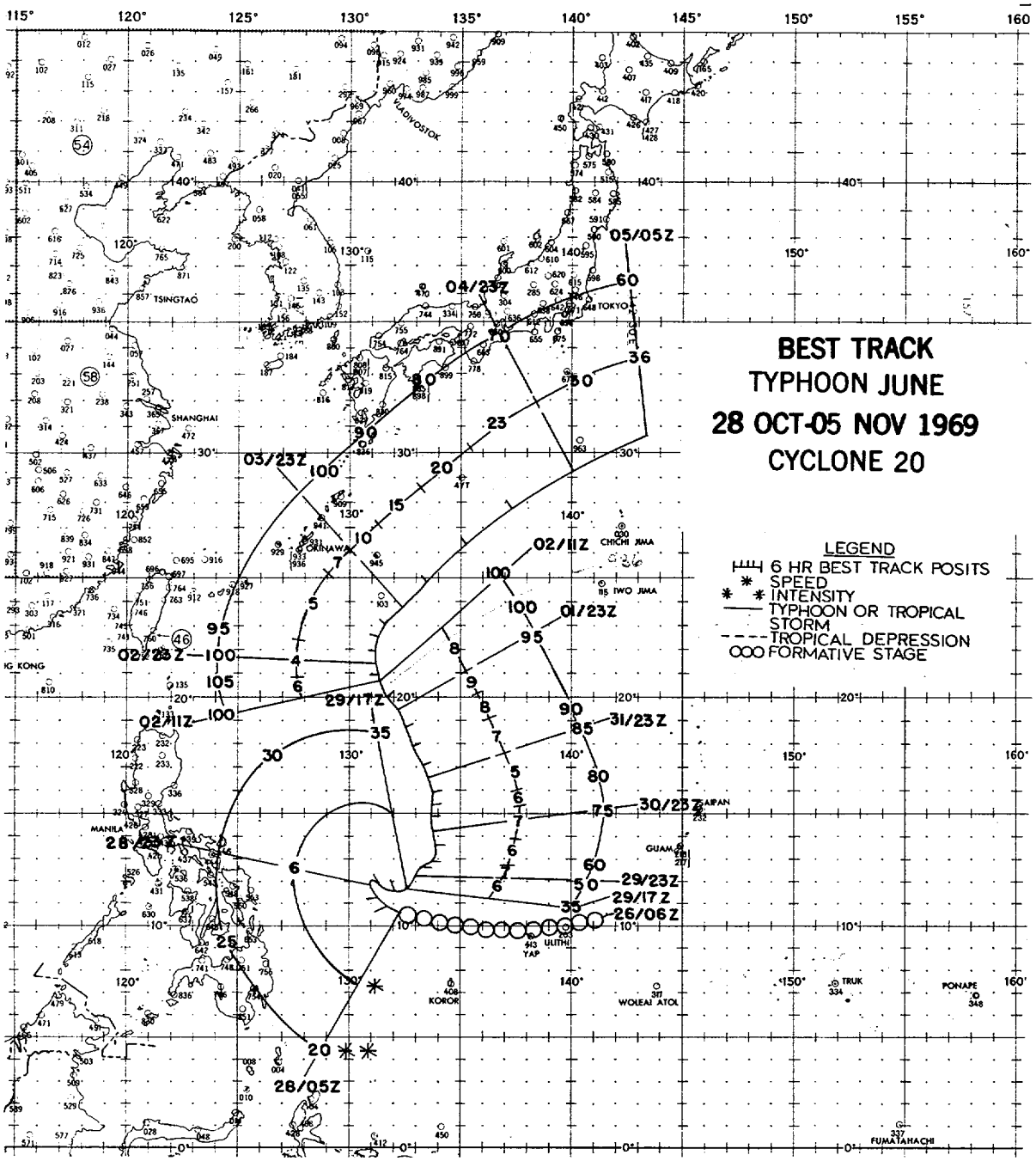
A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX
1. JUNCTION VORTEX AT 260600Z
2. SURFACE PRESSURE LESS THAN 1005 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - SOUTHEAST
2. UPON REACHING TYPHOON INTENSITY - ANTICYCLONIC

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL


BEST TRACK
TYPHOON JUNE
28 OCT-05 NOV 1969
CYCLONE 20
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
05/05Z
04/23Z
03/23Z
02/11Z
01/23Z
31/23Z
30/23Z
29/23Z
29/17Z
28/05Z
26/06Z
02/23Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
FUMATAHACHI

EYE FIXES CYCLONE 20

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	OBS FLT LVL WND	OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL T/TD	EYE FORM	ORIEN-TATION	EYE DIA	THKNS WALL CLOUD
1	270445Z	10.0N 135.0E	SLTLS	STG 3	DIA -- BNDS -								
2	280245Z	10.5N 132.4E	54-P------		---	020	004	---	--/--	----			N.F.B.
3	280544Z	10.5N 132.0E	SLTLS	STG C	DIA -- BNDS -								
4	281458Z	12.1N 131.5E	VW-P----10	0450M	---	025	001	---	--/--	----			N.F.B.
5	290245Z	11.5N 131.7E	54-P----05	0410M	044	030	999	---	25/25	----			N.F.B.
6	290447Z	13.0N 132.0E	SLTLS	STG C	DIA -- BNDS -								
7	290911Z	12.0N 131.0E	VW-R----30		---	---	---	---	--/--	----			--
8	291045Z	11.8N 131.2E	VW-P----10	700MB	038	030	991	3072	13/--	----			N.F.B.
9	291448Z	11.6N 131.8E	VW-P----15	0450M	---	030	989	---	24/22	----			N.F.B.
10	292045Z	12.0N 133.1E	54-P----10	700MB	045	---	984	2947	14/10	----			F.B.
11	292330Z	12.3N 133.1E	54-P----06	700MB	055	065	982	2951	16/12	----			F.B.
12	300300Z	12.7N 133.1E	54-P----05	700MB	060	060	982	2935	17/13	----			F.B.
13	300546Z	12.5N 133.0E	SLTLS	STG C	DIA -- BNDS -								
14	300852Z	12.2N 134.0E	VW-R----15		040	045	---	---	--/--	----			F.B.
15	300935Z	12.6N 133.7E	VW-P----10	0310M	---	045	981	---	28/26	ELIP	NW-SE	40X--	F.B.
16	301200Z	13.2N 134.1E	VW-R----15		035	045	---	---	--/--	ELIP	NW-SE	22X--	F.B.
17	301440Z	13.0N 134.0E	VW-P----05	0410M	---	055	979	3024	27/25	CONC		25---	F.B.
18	302040Z	14.0N 133.8E	54-P----10	700MB	075	---	976	2780	16/10	ELIP	N-S	30X15	10
19	310245Z	14.6N 133.6E	54-P----08	700MB	060	075	973	2847	18/14	CIRC	----	40	10
20	310454Z	14.5N 132.5E	SLTLS	STG X	DIA 05 BNDS 2								
21	310901Z	15.3N 133.4E	VW-R----15		---	---	---	---	--/--	CIRC	----	25	10
22	311445Z	15.5N 133.8E	VW-R----05		---	---	---	---	--/--	CIRC	----	16	08
23	312100Z	16.3N 133.4E	54-P----20	700MB	060	---	971	2859	20/16	CIRC	----	20	06
24	010230Z	16.8N 133.2E	54-P----10	700MB	090	120	962	2783	23/12	----			06
25	010548Z	17.0N 132.5E	SLTLS	STG X	DIA 03 BNDS 3								
26	010715Z	17.3N 132.9E	VW-R------		---	---	---	---	--/--	----			--
27	010945Z	17.1N 133.0E	VW-R------		---	---	---	---	--/--	----			--
28	011000Z	17.5N 132.9E	VW-P----03	0250M	---	080	964	2830	25/25	CIRC	----	20	F.B.
29	011503Z	18.5N 132.6E	VW-P----03	700MB	---	---	966	2816	18/14	CIRC	----	22	F.B.
30	011503Z	18.5N 132.6E	VW-P----03	700MB	---	---	966	2816	18/14	CIRC	----	22	F.B.
31	020200Z	19.8N 131.9E	54-P----05	700MB	110	100	945	2646	20/12	CIRC	----	35	--
32	020456Z	20.0N 131.5E	SLTLS	STG X	DIA 03 BNDS 4								
33	020755Z	20.2N 131.4E	VW-R------		---	---	---	---	--/--	----			--
34	020820Z	20.4N 131.5E	VW-P----05	0280M	---	110	936	---	24/21	CIRC	----	25	--
35	020820Z	20.4N 131.5E	VW-P----05	0280M	---	110	936	---	24/21	CIRC	----	25	--
36	021420Z	20.8N 131.4E	VW-P----03	700MB	100	---	944	2643	--/10	CIRC	----	30	--
37	022110Z	21.3N 130.9E	54-P----05	700MB	080	100	959	2716	18/12	CIRC	----	25	05
38	030100Z	21.4N 131.1E	54-P----05	700MB	085	075	961	2737	18/13	CIRC	----	30	--
39	030903Z	22.2N 131.2E	VW-P----02	0260M	095	100	963	---	24/22	CIRC	----	30	--
40	031200Z	22.4N 131.2E	VW-R----05		---	---	---	---	--/--	CIRC	----	25	--
41	031510Z	22.8N 131.4E	VW-P----02	700MB	085	---	956	2843	17/13	CIRC	----	25	--
42	032015Z	23.3N 132.0E	54-P----08	700MB	083	---	963	2768	17/16	CIRC	----	40	--
43	040326Z	24.5N 133.0E	54-P----05	700MB	120	120	965	2789	23/14	CIRC	----	40	--
44	040454Z	25.5N 133.0E	SLTLS	STG X	DIA 04 BNDS 4								
45	040850Z	26.9N 134.7E	VW-P----15		---	---	---	---	--/--	----			--
46	040930Z	25.8N 134.8E	VW-P----05	0240M	---	085	965	---	26/20	CIRC	----	43	--
47	041230Z	26.6N 135.6E	VW-P----20		---	---	---	---	--/--	CIRC	----	57	--
48	041450Z	27.1N 136.2E	VW-P----05	700MB	085	---	970	2957	20/10	CIRC	----	52	--
49	041450Z	27.1N 136.2E	VW-P----05	700MB	085	---	970	2957	20/10	CIRC	----	52	--
50	050200Z	30.3N 141.8E	54-P----20	700MB	100	065	980	2899	17/14	----			F.B.

TYPHOON JUNE

TROPICAL CYCLONE 20 -- 10/28/0500Z TO 11/05/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
07	291700Z	11.6N	131.4E	11.7N	132.6E	12.4N	130.5E	305-0270	-	-	--------	-	-	--------
08	292300Z	12.2N	133.1E	12.2N	133.0E	14.1N	133.7E	273-0198	16.1N	134.0E	--------	-	-	--------
09	300500Z	12.9N	133.2E	12.7N	133.2E	15.7N	134.5E	247-0132	19.2N	136.4E	--------	23.1N	139.7E	--------
10	301100Z	12.8N	133.7E	12.8N	133.8E	14.4N	134.8E	271-0258	16.2N	135.7E	--------	-	-	--------
11	301700Z	13.2N	134.1E	13.5N	133.9E	15.0N	135.0E	252-0204	16.5N	135.5E	--------	18.0N	136.2E	--------
12	302300Z	14.2N	134.0E	14.2N	133.7E	16.0N	134.8E	180-0006	17.8N	135.7E	--------	-	-	--------
13	310500Z	14.7N	133.8E	14.8N	133.7E	16.9N	134.4E	038-0066	19.4N	135.9E	--------	22.4N	138.7E	--------
14	311100Z	15.5N	133.5E	15.3N	133.8E	18.2N	133.7E	134-0072	21.2N	135.2E	--------	-	-	--------
15	311700Z	15.8N	133.6E	15.8N	133.7E	18.4N	133.9E	123-0084	21.4N	135.2E	--------	24.7N	137.3E	--------
16	312300Z	16.5N	133.5E	16.4N	133.4E	19.1N	134.1E	107-0078	22.5N	135.9E	269-0540	-	-	--------
17	010500Z	17.0N	133.4E	17.0N	133.2E	19.5N	133.6E	095-0066	22.4N	134.6E	054-0222	25.6N	137.3E	--------
18	011100Z	17.6N	133.0E	17.8N	132.8E	20.0N	133.1E	064-0048	22.8N	134.7E	120-0186	-	-	--------
19	011700Z	18.8N	132.5E	18.6N	132.5E	21.8N	133.2E	098-0078	24.6N	136.3E	126-0210	27.9N	140.1E	--------
20	012300Z	19.5N	132.3E	19.4N	132.2E	22.6N	132.5E	099-0102	25.5N	135.5E	115-0216	-	-	--------
21	020500Z	20.2N	131.8E	20.0N	131.7E	23.3N	132.1E	106-0102	26.3N	134.2E	098-0234	29.5N	137.4E	068-0480
22	021100Z	20.8N	131.4E	20.6N	131.4E	23.8N	132.2E	111-0096	26.7N	134.5E	081-0210	-	-	--------
23	021700Z	21.0N	131.3E	20.9N	131.3E	23.9N	132.3E	063-0114	27.4N	135.2E	083-0216	30.9N	139.5E	122-0324
24	022300Z	21.5N	130.8E	21.3N	131.1E	23.1N	130.0E	046-0108	24.7N	129.9E	075-0270	-	-	--------
25	030500Z	21.5N	130.9E	21.8N	131.1E	22.7N	130.6E	051-0138	23.9N	130.7E	080-0192	25.7N	131.7E	086-0420
26	031100Z	22.4N	131.0E	22.4N	131.2E	24.3N	131.9E	033-0096	26.8N	134.2E	083-0192	-	-	--------
27	031700Z	23.0N	131.5E	23.0N	131.6E	25.2N	133.4E	034-0060	27.7N	136.1E	070-0270	30.7N	139.7E	072-0324
28	032300Z	23.5N	132.2E	23.7N	132.3E	26.1N	135.2E	255-0126	29.3N	139.4E	059-0204	-	-	--------
29	040500Z	24.7N	133.2E	24.8N	133.4E	29.3N	137.6E	230-0192	34.2N	144.8E	026-0096	-	-	078-0210
30	041100Z	26.2N	135.2E	26.2N	135.1E	34.4N	144.8E	237-0204	-	-	314-0042	-	-	--------
31	041700Z	27.6N	136.9E	27.7N	137.1E	34.6N	144.9E	233-0246	-	-	260-0096	-	-	086-0156
32	042300Z	29.2N	140.0E	29.2N	140.0E	-	-	234-0312	-	-	244-0600	-	-	--------
33	050500Z	31.3N	143.6E	31.5N	143.3E	-	-	246-0318	-	-	236-0810	-	-	249-0324

AVERAGE 24 HOUR ERROR - 0139 MI.
AVERAGE 48 HOUR ERROR - 0267 MI.
AVERAGE 72 HOUR ERROR - 0319 MI.

TYPHOON KATHY - 11/03/0500Z TO 11/08/2300Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 24
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 19
3. DISTANCE TRAVELED DURING WARNING PERIOD - 2040 MI

B. CHARACTERISTICS AS A TYPHOON
1. MINIMUM OBSERVED SLP - 930 MBS AT 072100Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2478 M AT 072100Z
3. MAXIMUM SURFACE WIND - 110 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 420 MI

II. DEVELOPMENT

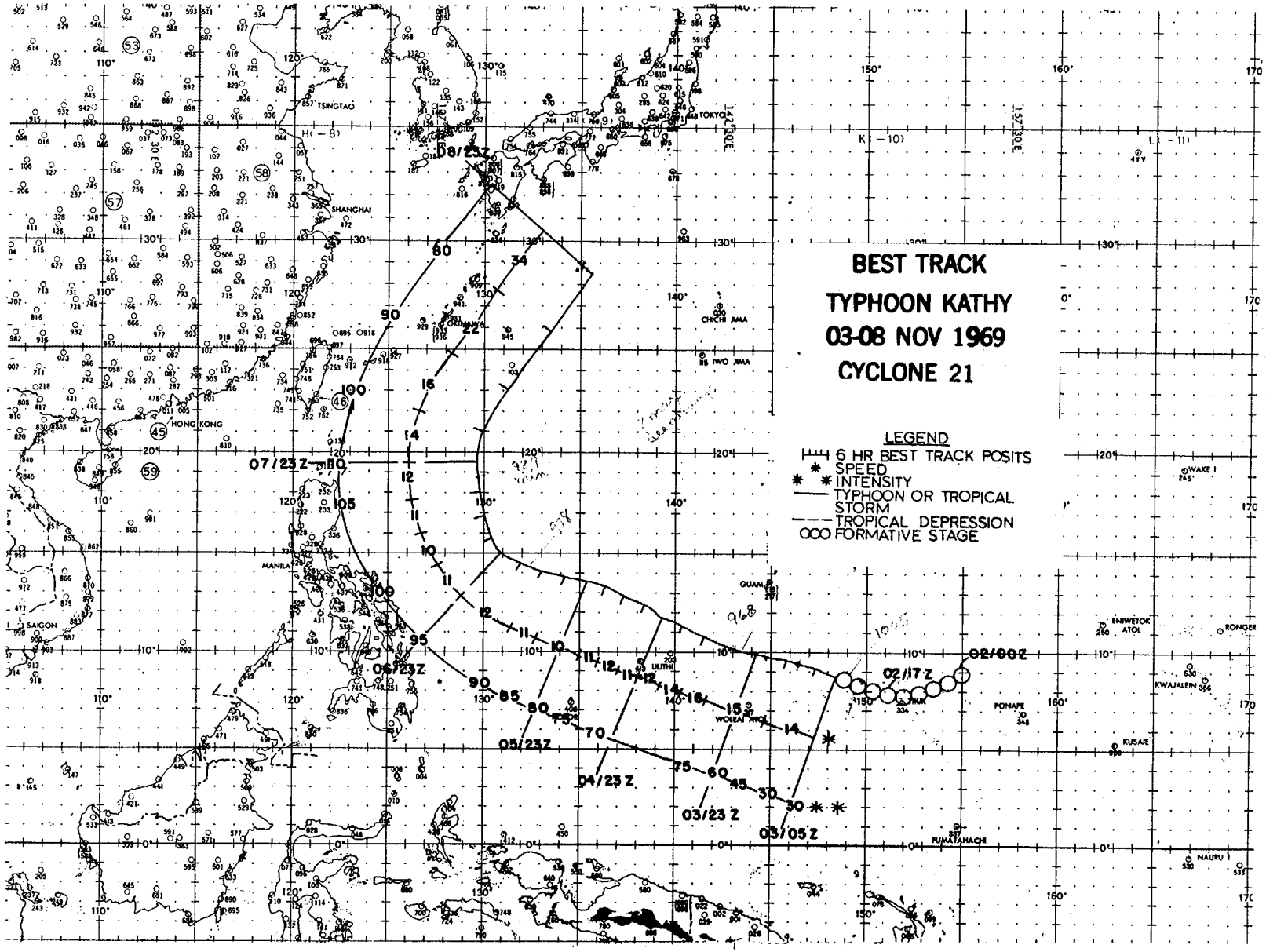
A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX
1. JUNCTION VORTEX AT 020000Z
2. SURFACE PRESSURE LESS THAN 1006 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX
1. INITIAL - NORTHEAST
2. UPON REACHING TYPHOON INTENSITY - ANTICYCLONIC

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL


BEST TRACK
TYPHOON KATHY
03-08 NOV 1969
CYCLONE 21
LEGEND
6 HR BEST TRACK POSITS
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
08/23Z
07/23Z
06/23Z
05/23Z
04/23 Z
03/23 Z
03/05 Z
02/00Z
02/17 Z
TSINGTAO
SHANGHAI
TOKYO
CHICHI JIMA
HONG KONG
MANILA
SAIGON
GUAM
WAKE I
ENIWETOK ATOL
RONGER
KWAJALEIN
PONAPE
KUSAIE
NAURU I
FUMATAHACHI

EYE FIXES CYCLONE 21

FIX NO.	TIME	POSITION	UNIT-METHOD-ACCY	FLT LVL	OBS FLT LVL WIND	OBS SFC WIND	OBS MIN SLP	MIN 700MB HGT	FLT LVL FT/TO	EYE FORM	ORIEN-TATION	EYE DIA	TRANS WALL CLOUD
1	030314Z	08.5N 149.0E	54-P------		020	020	005	---	--/--	----			--
2	030355Z	09.0N 148.5E	SLTLS	STG C	DIA -- BNDS -								
3	031420Z	09.4N 146.4E	VW-R----05		---	---	---	---	--/--	----			--
4	031440Z	09.4N 146.4E	VW-P----02		---	060	997	---	--/--	CIRC	----	16	05
5	031915Z	09.6N 145.3E	54-P----05	0390M	060	---	987	---	30/20	CIRC	----	15	06
6	032110Z	09.7N 144.9E	54-P----05	700MB	065	060	~~985~~	2850	15/10	ELIP	N-S	20X12	06
7	040015Z	10.0N 144.1E	54-P----05	700MB	060	065	969	2844	17/10	CIRC	----	08	-
8	040230Z	10.2N 143.2E	54-P----05	700MB	075	080	968	2844	18/10	CIRC	----	08	--
9	040450Z	10.0N 142.0E	SLTLS	STG S	DIA -- BNDS -								
10	042055Z	11.4N 139.6E	54-P----03	700MB	060	075	976	2899	16/10	CIRC	----	15	06
11	050255Z	12.3N 138.5E	54-P----05	700MB	073	080	976	2914	20/12	CIRC	----	10	--
12	050543Z	13.0N 137.5E	SLTLS	STG X	DIA 04 BNDS 2								
13	050905Z	12.7N 137.1E	VW-R----05		---	---	---	---	--/--	CIRC	----	10	10
14	051130Z	13.0N 137.0E	ACFT RDR		---	---	---	---	--/--	----			--
15	051505Z	13.1N 136.7E	VW-P----05	700MB	---	---	---	2972	14/10	CIRC	----	14	08
16	052100Z	13.4N 135.9E	54-P----10	700MB	070	100	982	2950	22/10	ELIP	NW-SE	25X15	06
17	060240Z	13.5N 134.7E	54-P----05	700MB	100	115	984	2947	22/13	CIRC	----	30	04
18	060459Z	14.0N 134.0E	SLTLS	STG X	DIA 04 BNDS 2								
19	060900Z	13.8N 133.8E	VW-R----15		---	---	---	---	--/--	----			--
20	060955Z	13.9N 133.2E	VW-P----15	0220M	---	090	971	---	26/23	CIRC	----	38	14
21	061435Z	14.2N 132.0E	VW-P----10	700MB	090	---	978	2920	18/11	CIRC	----	32	12
22	062055Z	14.7N 131.0E	54-P----05	700MB	---	---	961	2768	14/10	CIRC	----	25	05
23	070210Z	15.2N 130.5E	54-P----07	700MB	080	090	949	2646	18/11	CIRC	----	25	04
24	070554Z	16.0N 130.0E	SLTLS	STG X	DIA 04 BNDS 4								
25	070701Z	15.5N 130.0E	ACFT RDR		---	---	---	---	--/--	CIRC	----	80	--
26	070925Z	16.3N 130.1E	VW-R----03		---	---	---	---	--/--	ELIP	NW-SE	12X06	--
27	071200Z	16.8N 130.0E	VW-R----10		---	---	---	---	--/--	----			--
28	071430Z	17.6N 129.9E	VW-R----05		---	---	---	---	--/--	CIRC	----	12	06
29	072100Z	19.0N 129.7E	54-P----08	700MB	100	---	~~918~~	2478	22/14	CIRC	----	15	05
30	080200Z	20.2N 129.8E	54-P----05	700MB	100	100	940	2576	22/13	CIRC	----	20	05
31	080830Z	22.6N 131.1E	VW-R----05		---	---	---	---	--/--	----			--
32	080848Z	22.2N 130.7E	VW-R----05		---	110	---	---	--/--	CIRC	----	40	--
33	081200Z	23.4N 131.6E	VW-R----10		---	---	---	---	--/--	CIRC	----	25	--
34	081516Z	24.8N 132.8E	VW-P----05	700MB	---	---	---	2926	18/16	CIRC	----	40	--
35	082110Z	27.8N 133.8E	54-P----02	700MB	110	---	999	3030	10/06	----			N.F.B.
36	082330Z	28.6N 136.1E	54-P------	700MB	---	035	---	3030	07/07	CIRC	----	40	N.F.B.

TYPHOON KATHY

TROPICAL CYCLONE 21 -- 11/03/0500Z TO 11/08/2300Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT LAT	WARNING POSIT LONG	BEST TRACK LAT	BEST TRACK LONG	24 HR FCST LAT	24 HR FCST LONG	24 HR ERROR DEG DIST	48 HR FCST LAT	48 HR FCST LONG	48 HR ERROR DEG DIST	72 HR FCST LAT	72 HR FCST LONG	72 HR ERROR DEG DIST
03	031700Z	09.5N	145.8E	09.6N	145.8E	12.7N	141.6E	--------	15.4N	140.6E	--------	17.8N	140.5E	--------
04	032300Z	09.9N	144.6E	09.9N	144.3E	12.6N	141.6E	--------	15.3N	140.6E	--------	-	-	--------
05	040500Z	10.4N	142.7E	10.3N	142.7E	13.0N	137.1E	101-0060	15.2N	131.8E	--------	16.0N	126.0E	--------
06	041100Z	11.2N	140.9E	10.7N	141.4E	13.3N	133.9E	094-0144	14.1N	127.5E	--------	-	-	--------
07	041700Z	11.9N	139.1E	11.2N	140.3E	13.6N	132.2E	039-0114	14.2N	125.7E	--------	14.4N	119.6E	--------
08	042300Z	11.5N	139.2E	11.7N	139.3E	12.7N	135.4E	068-0138	13.0N	131.3E	--------	-	-	--------
09	050500Z	12.6N	138.1E	12.4N	138.3E	16.3N	135.8E	298-0072	20.3N	137.5E	--------	24.1N	141.3E	--------
10	051100Z	13.2N	136.8E	12.8N	137.3E	16.7N	134.6E	278-0198	20.0N	136.7E	--------	-	-	--------
11	051700Z	13.4N	136.5E	13.2N	136.3E	16.4N	134.4E	275-0234	19.8N	136.3E	062-0276	22.7N	140.8E	--------
12	052300Z	13.6N	135.6E	13.5N	135.3E	15.4N	133.0E	172-0048	17.7N	132.7E	071-0324	-	-	--------
13	060500Z	13.6N	134.4E	13.7N	134.2E	15.3N	130.8E	030-0180	17.9N	129.1E	303-0162	20.8N	130.9E	--------
14	061100Z	14.0N	133.1E	14.0N	133.0E	16.0N	129.0E	030-0180	18.6N	126.6E	271-0318	-	-	--------
15	061700Z	14.5N	131.6E	14.4N	131.9E	16.8N	127.8E	051-0186	20.2N	126.3E	269-0360	23.7N	127.6E	068-0528
16	062300Z	14.9N	130.6E	14.9N	130.9E	17.8N	127.0E	067-0120	21.7N	126.5E	171-0114	-	-	--------
17	070500Z	15.4N	130.0E	15.7N	130.3E	18.1N	127.4E	134-0030	21.2N	127.1E	056-0492	26.3N	131.4E	274-0246
18	071100Z	16.4N	129.8E	16.8N	130.0E	19.6N	129.2E	229-0072	23.9N	131.9E	064-0420	-	-	--------
19	071700Z	18.0N	129.6E	18.0N	129.8E	23.0N	131.4E	238-0132	29.8N	139.5E	074-0378	39.8N	152.9E	250-0624
20	072300Z	19.5N	129.7E	19.4N	129.7E	25.6N	133.8E	238-0174	32.8N	143.9E	121-0192	-	-	--------
21	080500Z	21.0N	130.1E	21.0N	130.0E	27.2N	135.7E	220-0222	35.0N	146.7E	195-0192	-	-	074-0648
22	081100Z	22.9N	131.2E	23.0N	131.2E	30.0N	139.9E	208-0228	-	-	225-0366	-	-	--------
23	081700Z	25.5N	133.4E	25.7N	133.4E	34.8N	147.0E	214-0192	-	-	230-0510	-	-	113-0444
24	082300Z	28.8N	134.5E	28.4N	135.7E	-	-	212-0190	-	-	232-0636	-	-	--------

AVERAGE 24 HOUR ERROR - 0145 MI.
AVERAGE 48 HOUR ERROR - 0338 MI.
AVERAGE 72 HOUR ERROR - 0498 MI.

ANNEX

A

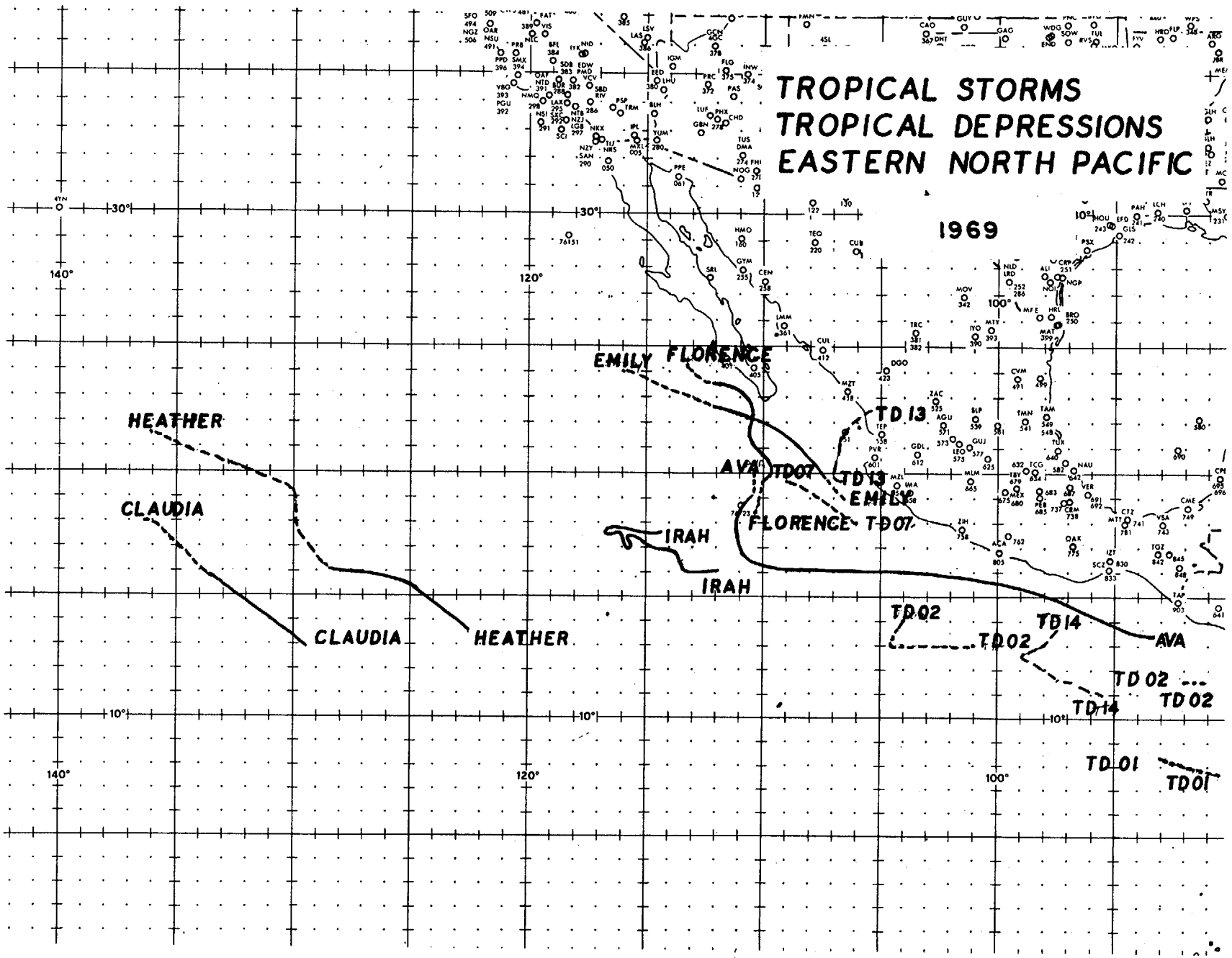
SUMMARY OF TROPICAL CYCLONES

IN THE

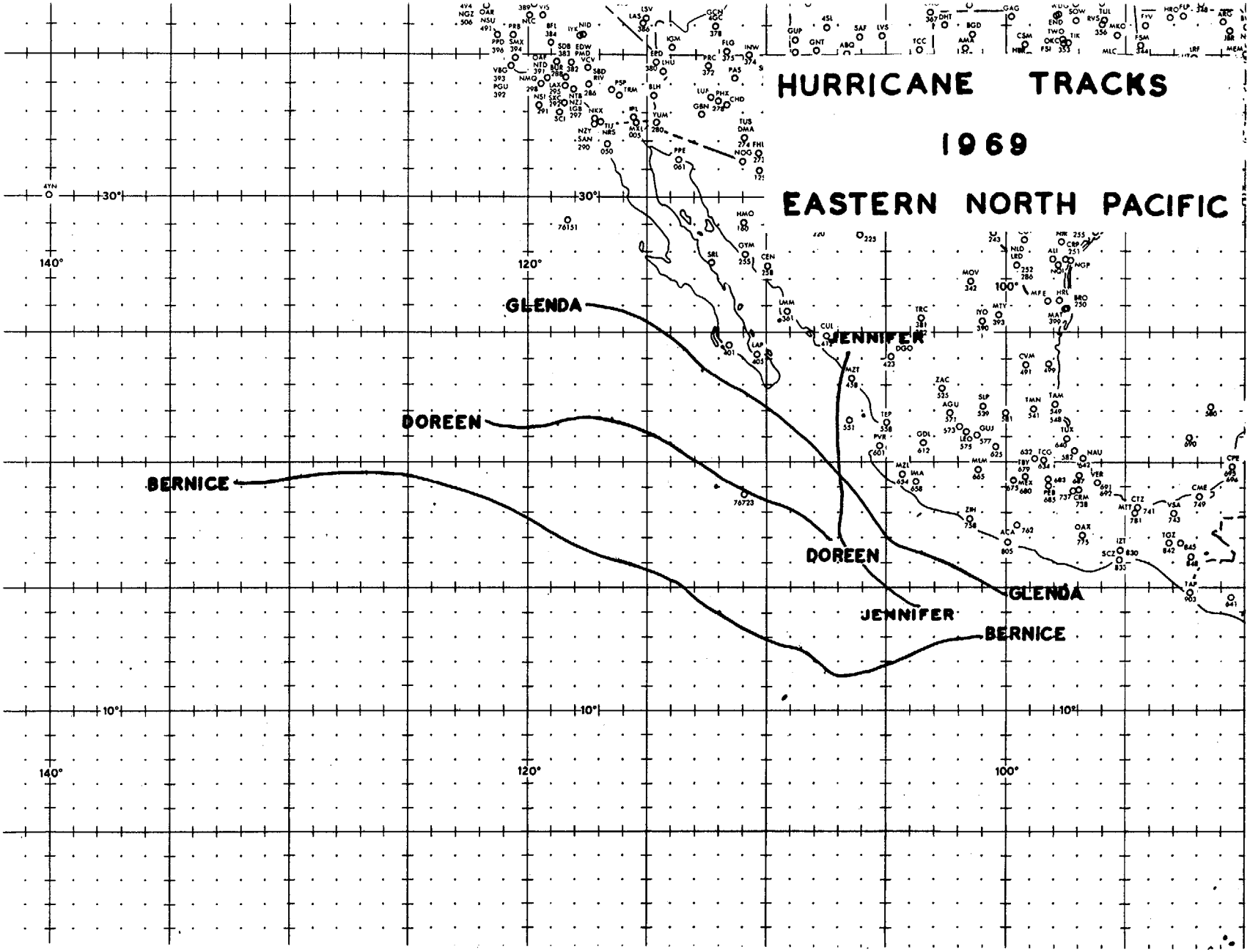
EASTERN NORTH PACIFIC OCEAN

FOR

1969


TROPICAL STORMS
TROPICAL DEPRESSIONS
EASTERN NORTH PACIFIC
1969
EMILY
FLORENCE
HEATHER
CLAUDIA
AVA
TD07
TD13
IRAH
TD02
TD14
TD01
30°
120°
140°
100°
10°

AN-1


HURRICANE TRACKS
1969
EASTERN NORTH PACIFIC
GLENDA
DOREEN
BERNICE
JENNIFER
30°
10°
140°
120°
100°

AN-2

During the 1969 EastPac Tropical Cyclone season, Fleet Weather Central, Alameda, issued a total of 219 Tropical Warnings on four hurricanes, six tropical storms and five tropical depressions. No tropical cyclones originating in Fleet Weather Central, Alameda's area moved out of the area. The 15 tropical cyclones identified this year is the lowest number since 1965 and the number of warnings was the lowest since 1964, reflecting an unusually inactive season. No specific reasons for this apparent inactivity have been determined.

The following eight year summary covering tropical cyclones originating in Fleet Weather Central, Alameda's area of responsibility is presented for comparison. Included are warnings issued by Fleet Weather Central, Pearl Harbor, when the tropical cyclone originated in the Alameda area.

	1962	1963	1964	1965	1966	1967	1968	1969
Total Number of Warnings*	122	80	60	244	342	474	531	219
Calandar Days of Warnings*	35	26	21	73	70	119	126	67
Tropical Depressions*				2	6	2	6	5
Tropical Storms	6	5	4	9	6	12	13	6
Hurricanes	2	4	2	1	7	6	6	4
Total Tropical Cyclones*	8	9	6	12	19	20	25	15

*Tropical Depression information not available 1962-1964

Jennifer was the only tropical cyclone that caused damage on land. One person was killed, 15 injured and a large ferry and 12 shrimp boats were reported swamped at Mazatlan, Mexico. Thirty other shrimp boats were reported lost in smaller harbors nearby. There was extensive property damage along a 100 mile section of the coast but information on money amounts and specific losses are not available. The highest reported winds at Mazatlan Airport were 50 knots with gusts to 70 at 2100Z, 11 October.

Forecasting tools used included twice daily readouts of the Fleet Numerical Weather Central's "HATRACK" steering program, extrapolation and subjective reasoning. While a definitive study of the various techniques has not been made, the latter two methods, coordinated with the Hurricane Warning Office, ESSA Weather Bureau, San Francisco, appear to be the most successful.

This season marked the inauguration of U. S. Navy responsibility in the Eastern Pacific for tropical cyclone reconnaissance. Efforts were limited by resources (two EC-131 aircraft and two meteorological crews operating from the Pacific Missile Range, Pt. Mugu, California) and no rountinely available staging points from which to base aircraft to cover distant storms (more than 1200 nautical miles from Pt. Mugu). Early in the season Acapulco, Mexico was used but 48 hours advance notification was required. Later in the season, limited funds precluded the use of Acapulco except in an emergency. Because of the aircraft configuration (EC-121 vice WC-121), penetrations could not be made and low level eye data was not available. The USAF continued to fly tropical cyclone reconnaissance missions in addition to scheduled Navy flights. High level reconnaissance data are available from that source.

Limited resources, coupled with the great distance at which most of the tropical cyclones were found caused APT data to remain as in previous years, the primary source of fixes. Insufficient reconnaissance data were available to make any meaningful verification of tropical cyclone intensity estimates based on satellite pictures.

TROPICAL CYCLONES FOR THE 1969 SEASON

ORIGINATED BY FLEET WEATHER CENTRAL, ALAMEDA

	CYCLONE	PERIOD
01	Tropical Depression 01	31 May 1969
02	Tropical Depression 02	04 June-05 June 1969
	REGENERATED	07 June-08 June 1969
03	Tropical Storm AVA	02 July-07 July 1969
04	Hurricane BERNICE	08 July-17 July 1969
05	Tropical Storm CLAUDIA	21 July-23 July 1969
06	Hurricane DOREEN	04 August-09 August 1969
07	Tropical Depression 07	09 August 1969
08	Tropical Storm EMILY	22 August-24 August 1969
09	Tropical Storm FLORENCE	02 September-07 September 1969
10	Hurricane GLENDA	08 September-12 September 1969
11	Tropical Storm HEATHER	18 September-22 September 1969
	REGENERATED	23 September-25 September 1969
12	Tropical Storm IRAH	30 September-03 October 1969
13	Tropical Depression 13	03 October-04 October 1969
14	Tropical Depression 14	03 October-05 October 1969
15	Hurricane JENNIFER	08 October-12 October 1969

Below is a summary of aircraft fixes made on hurricanes and tropical storms during the 1969 season.

CYCLONE	DATE/TIME REQ.	DATE/TIME FIX	REMARKS
DOREEN	061800Z	061730Z	
4-9 Aug	071800Z	071800Z	USAF FIX ALSO AT 071800Z 071800Z
	081800Z	081905Z	
EMILY	240000Z	232300Z	USAF FIX ALSO AT 231840Z
22-24 Aug			
FLORENCE	031800Z	031755Z	
2-7 Sep	050000Z	042340Z	USAF FIX ALSO AT 041824Z
	060000Z	052315Z	USAF FIX ALSO AT 951732Z
	080000Z	CANCELED	USAF FIX AT 061805Z. NAVY RECON CANCELED DUE STORM DISSIPATION
GLENDA	091800Z	091800Z	USAF FIX ALSO AT 091748Z
8-12 Sep	110000Z	110000Z	USAF FIX ALSO AT 101730Z
	120000Z	120030Z	USAF FIX ALSO AT 111713Z
HEATHER	NO NAVY RECON REQUESTED		USAF FIX AT 201825Z
18-25 Sep			USAF FIX AT 211809Z
IRAH	011800Z	011900Z	USAF FIX ALSO AT 011800Z
30 Sep-	030000Z	NO FIX	ACFT FLEW BUT UNABLE TO
3 Oct			LOCATE DISCERNABLE CENTER
JENNIFER	110000Z	NO FIX	ACFT NOT AVAIL FOR RECON
8-12 Oct			FLIGHT. USAF FIXED AT 091800Z AND 101740Z
	120000Z	CANCELED	STORM DISSIPATED. USAF FIX AT 111800Z

A total of 15 requests for Navy reconnaissance were made and two were subsequently canceled. Of the 13 remaining requests, only one could not be met and that was due to non-availability of aircraft. Twelve Navy reconnaissance flights were made. During the same period the U.S. Air Force 9th Weather Reconnaissance Wing flew 14 missions.

TROPICAL DEPRESSIONS 1969
POSITION DATA

TROPICAL DEPRESSION ZERO ONE
31 MAY 1969

DTG	LAT	LONG	DTG	LAT	LONG
310600Z	07.8N	90.4W	311800Z	08.2N	93.0W
311200Z	08.0N	92.0W			

TROPICAL DEPRESSION ZERO TWO
04 JUN - 05 JUN 1969

DTG	LAT	LONG	DTG	LAT	LONG
041600Z	11.5N	91.0W	*071800Z	13.0N	104.5W
041800Z	11.5N	91.3W	080000Z	13.5N	105.0W
050000Z	11.5N	92.0W	080600Z	13.7N	105.7W
**070000Z	13.5N	102.5W	081200Z	13.7N	106.0W
*070600Z	13.0N	101.0W	081800Z	14.0N	104.0W
071200Z	13.3N	102.0W			

TROPICAL DEPRESSION ZERO SEVEN
09 AUG 1969

DTG	LAT	LONG	DTG	LAT	LONG
090000Z	18.0N	106.0W	091200Z	18.6N	107.6W
090600Z	18.4N	106.8W	091800Z	19.8N	109.0W

TROPICAL DEPRESSION ONE THREE
03 OCT - 04 OCT 1969

DTG	LAT	LONG	DTG	LAT	LONG
031800Z	20.0N	107.0W	040600Z	22.5N	105.5W
040000Z	21.2N	106.8W			

TROPICAL DEPRESSION ONE FOUR
03 OCT - 05 OCT 1969

DTG	LAT	LONG	DTG	LAT	LONG
031800Z	11.0N	95.5W	041800Z	13.0N	97.0W
040000Z	11.5N	97.3W	050000Z	13.5N	97.5W
040600Z	12.0N	98.0W	050600Z	DISSIPATED	
041200Z	12.6N	99.0W			

*RELOCATED
**REGENERATED

TROPICAL STORMS 1969
POSITION DATA

TROPICAL STORM AVA
2 JUL - 7 JUL

DTG	LAT	LONG	DTG	LAT	LONG
020600Z	13.4N	93.4W	050000Z	16.0N	109.0W
021200Z	13.5N	94.1W	050600Z	16.0N	110.0W
021800Z	13.6N	95.5W	051200Z	16.0N	112.5W
030000Z	13.8N	96.6W	*051800Z	16.5N	111.5W
030600Z	14.0N	97.6W	060000Z	16.7N	112.0W
031200Z	14.2N	98.6W	060600Z	16.8N	112.5W
*031600Z	15.8N	102.0W	061200Z	17.0N	113.0W
031800Z	16.0N	102.5W	*061800Z	18.5N	110.0W
040000Z	16.0N	103.5W	070000Z	19.2N	110.2W
040600Z	16.5N	104.5W	070600Z	19.9N	110.2W
041200Z	16.8N	105.5W	071200Z	20.0N	110.3W
*041800Z	16.0N	108.3W	071800Z	20.0N	110.3W

TROPICAL STORM CLAUDIA
21 JUL - 23 JUL

DTG	LAT	LONG	DTG	LAT	LONG
211800Z	13.0N	129.5W	*221800Z	15.7N	133.5W
220000Z	12.5N	131.0W	230000Z	16.5N	134.4W
220600Z	12.5N	132.0W	230600Z	17.3N	135.3W
221200Z	12.5N	133.0W	231200Z	18.0N	136.2W

TROPICAL ATORM EMILY
22 AUG - 24 AUG

DTG	LAT	LONG	DTG	LAT	LONG
221800Z	19.0N	106.5W	240000Z	22.7N	112.1W
230000Z	20.2N	106.6W	240600Z	23.1N	113.2W
230600Z	21.1N	107.3W	241200Z	23.6N	114.5W
231200Z	22.0N	108.2W	241800Z	24.0N	116.0W
231800Z	22.2N	110.8W			

* RELOCATED

TROPICAL STORM FLORENCE
02 SEP - 07 SEP

DTG	LAT	LONG	DTG	LAT	LONG
021800Z	18.5N	110.2W	050600Z	21.1N	110.0W
030000Z	19.3N	110.5W	051200Z	21.4N	110.0W
030600Z	20.0N	110.8W	051800Z	21.6N	110.6W
031200Z	20.8N	111.0W	060000Z	22.2N	110.4W
031800Z	19.6N	110.0W	060600Z	23.0N	111.6W
040000Z	20.0N	109.5W	*061200Z	23.1N	111.7W
040600Z	20.4N	109.3W	061800Z	23.5N	112.1W
041200Z	20.9N	109.1W	070000Z	23.8N	112.5W
041800Z	20.7N	110.0W	070600Z	24.2N	113.2W
050000Z	20.8N	110.0W			

TROPICAL STORM HEATHER
18 SEP - 22 SEP
23 SEP - 25 SEP

DTG	LAT	LONG	DTG	LAT	LONG
181800Z	13.5N	122.5W	220000Z	16.0N	128.5W
190000Z	13.8N	123.8W	*220600Z	17.0N	130.0W
190600Z	14.0N	124.8W	221200Z	17.3N	130.5W
191200Z	14.2N	125.8W	221800Z	17.6N	129.8W
*191800Z	15.3N	124.8W	**231800Z	19.2N	130.0W
200000Z	15.6N	125.5W	240000Z	20.0N	130.5W
200600Z	16.1N	126.3W	240600Z	20.4N	130.8W
201200Z	16.1N	126,8W	241200Z	20.7N	131.1W
201800Z	16.0N	127.5W	241800Z	20.4N	132.8W
210000Z	16.0N	127.7W	250000Z	20.7N	133.2W
210600Z	16.0N	128.4W	250600Z	21.0N	133.6W
211200Z	16.0N	129.0W	251200Z	21.3N	134.0W
211800Z	16.0N	128.0W	251800Z	21.5N	136.1W

TROPICAL STORM IRAH
30 SEP - 03 OCT

DTG	LAT	LONG	DTG	LAT	LONG
300000Z	16.0N	112.0W	020000Z	17.5N	116.0W
300600Z	16.0N	112.5W	020600Z	17.5N	116.5W
301200Z	16.0N	113.3W	021200Z	17.5N	117.0W
301800Z	16.8N	113.6W	021800Z	17.5N	114.5W
010000Z	16.9N	114.2W	030000Z	17.5N	114.5W
010600Z	17.2N	115.0W	030600Z	17.5N	114.5W
011200Z	17.5N	115.8W	031200Z	17.5N	114.5W
011800Z	17.0N	115.5W	031800Z	17.5N	114.5W

*RELOCATED
**REGENERATED

INDIVIDUAL HURRICANE TRACKS

FOR 1969

IN THE EASTERN NORTH PACIFIC OCEAN

NOTE: Due to a lack of reconnaissance data, accurate intensities could not be determined and thus are not included with the hurricane best tracks.

HURRICANE BERNICE - 07/08/1800Z TO 07/17/0600Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 35
2. NUMBER OF WARNINGS WITH HURRICANE INTENSITY - 8
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1994 MILES

B. CHARACTERISTICS

1. MINIMUM OBSERVED SLP - UNKNOWN
2. MINIMUM OBSERVED 700 MB HEIGHT - UNKNOWN
3. MAXIMUM SURFACE WIND - 75 KT (EST.)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 150 MILES

II. DEVELOPMENT

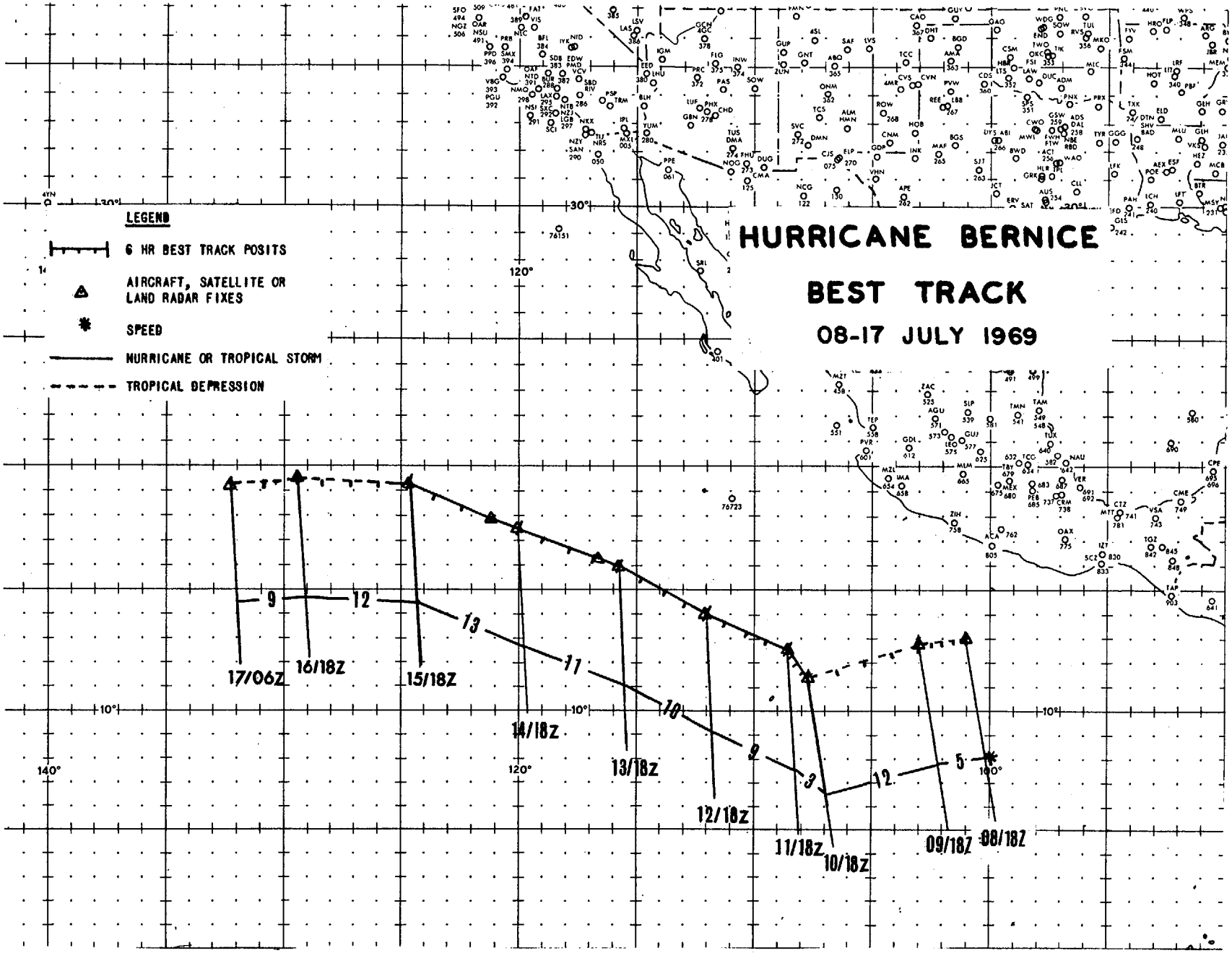
A. INITIAL IMPETUS - ITCZ

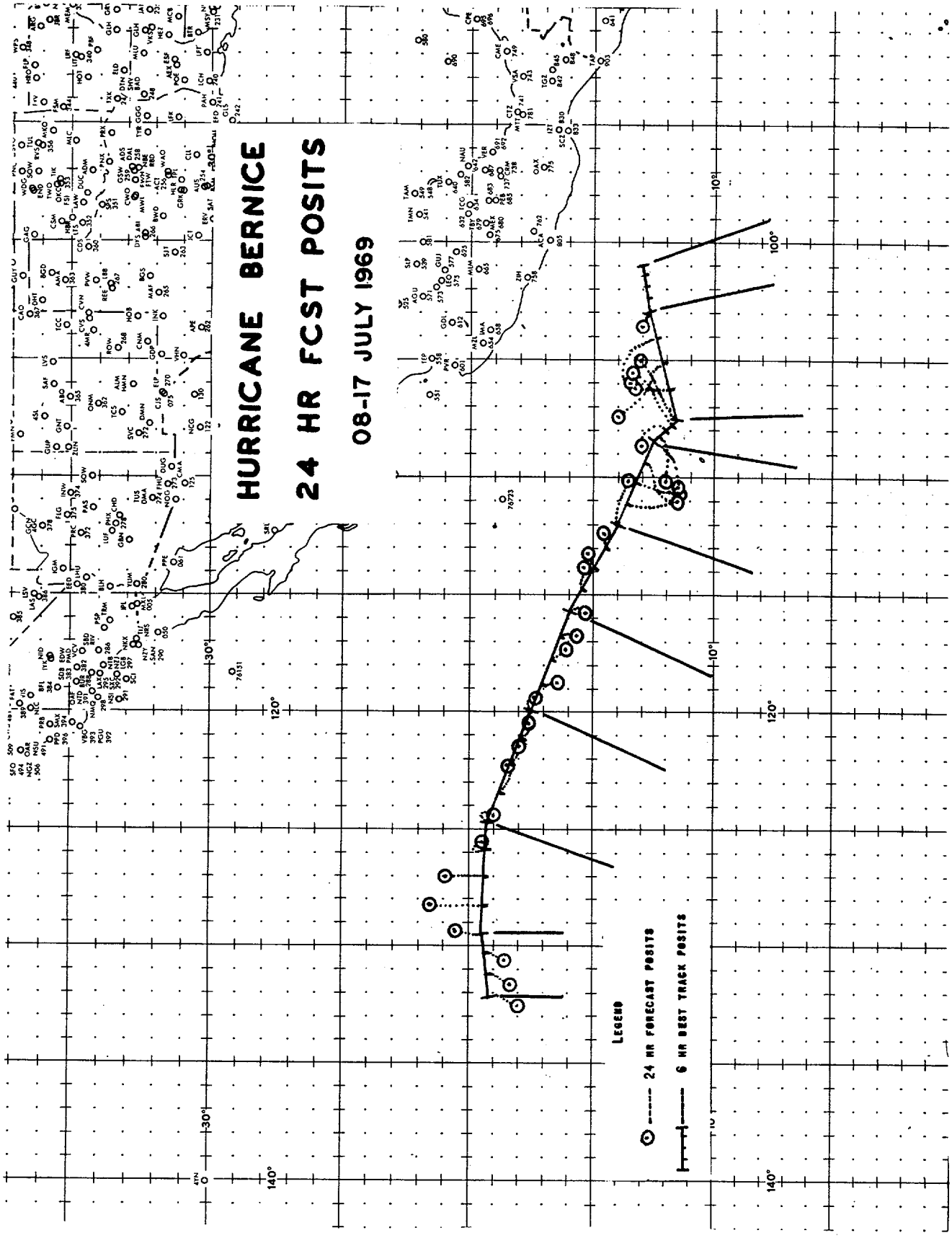
B. INITIAL SURFACE VORTEX
1. 081800Z
2. SURFACE PRESSURE LESS THAN 1008 MB

C. TIME STORM REACHED HURRICANE INTENSITY - 121800Z

III. FINAL DISPOSITION

A. DISSIPATED OVER WATER


HURRICANE BERNICE
BEST TRACK
08-17 JULY 1969
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT, SATELLITE OR LAND RADAR FIXES
SPEED
HURRICANE OR TROPICAL STORM
TROPICAL DEPRESSION
17/06Z
16/18Z
15/18Z
14/18Z
13/18Z
12/18Z
11/18Z
10/18Z
09/18Z
08/18Z
9
12
13
11
10
9
8
12
5
30°
120°
140°
10°


HURRICANE BERNICE
24 HR FCST POSITS
08-17 JULY 1969
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS

HURRICANE BERNICE
08-17 JULY 1969

DTG	LAT	LONG	24 HR ERROR	48 HR ERROR	72 HR ERROR
081800Z	13.0N	101.0W	-	-	-
090000Z	13.0N	102.5W	-	-	-
090600Z	13.2N	102.5W	-	-	-
091200Z	12.5N	102.5W	-	-	-
091800Z	12.8N	103.0W	300/33	-	-
100000Z	13.0N	103.5W	280/154	-	-
100600Z	13.0N	105.5W	295/134	-	-
101200Z	12.0N	107.0W	040/112	-	-
101800Z	11.5N	107.5W	060/178	-	-
110000Z	11.5N	108.2W	055/212	-	-
110600Z	11.5N	107.5W	320/114	-	-
111200Z	11.5N	108.0W	285/135	-	-
111800Z	12.5N	108.5W	240/123	-	-
120000Z	13.0N	109.5W	225/127	-	-
120600Z	13.5N	110.2W	190/122	-	-
121200Z	13.8N	111.0W	205/152	-	-
121800Z	14.0N	112.0W	105/110	200/162	-
130000Z	14.4N	113.0W	065/44	195/180	-
130600Z	14.8N	114.0W	060/58	125/210	-
131200Z	15.2N	114.9W	085/68	165/231	-
131800Z	16.0N	115.7W	190/42	110/238	-
140000Z	16.3N	116.6W	200/38	090/84	185/286
140600Z	16.6N	117.5W	220/40	075/72	-
141200Z	17.0N	118.5W	200/33	095/113	165/340
141800Z	17.5N	120.0W	100/31	120/58	-
150000Z	17.9N	121.1W	110/46	115/50	095/180
150600Z	18.5N	122.3W	115/65	115/78	-
151200Z	19.0N	123.5W	200/34	110/87	095/208
151800Z	19.3N	124.8W	110/25	120/90	-
160000Z	19.3N	126.0W	070/32	100/108	120/98
160600Z	19.1N	127.1W	005/106	005/123	-
161200Z	18.9N	128.2W	360/154	135/87	120/114
161800Z	19.5N	129.5W	010/60	045/41	-
170000Z	19.5N	130.7W	175/60	025/106	075/170
170600Z	19.3N	132.2W	115/72	010/226	-

24 HOUR FORECAST ERROR = 87.6 MILES
48 HOUR FORECAST ERROR = 123.4 MILES
72 HOUR FORECAST ERROR = 199.4 MILES

HURRICANE DOREEN - 08/04/1800Z TO 08/09/1200Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 20
2. NUMBER OF WARNINGS WITH HURRICANE INTENSITY - 6
3. DISTANCE TRAVELED DURING WARNING PERIOD - 875 MILES

B. CHARACTERISTICS
1. MINIMUM OBSERVED SLP - UNKNOWN
2. MINIMUM OBSERVED 700 MB HEIGHT - NOT OBSERVED
3. MAXIMUM SURFACE WIND - 75 KT (EST.)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 300 MILES

II. DEVELOPMENT

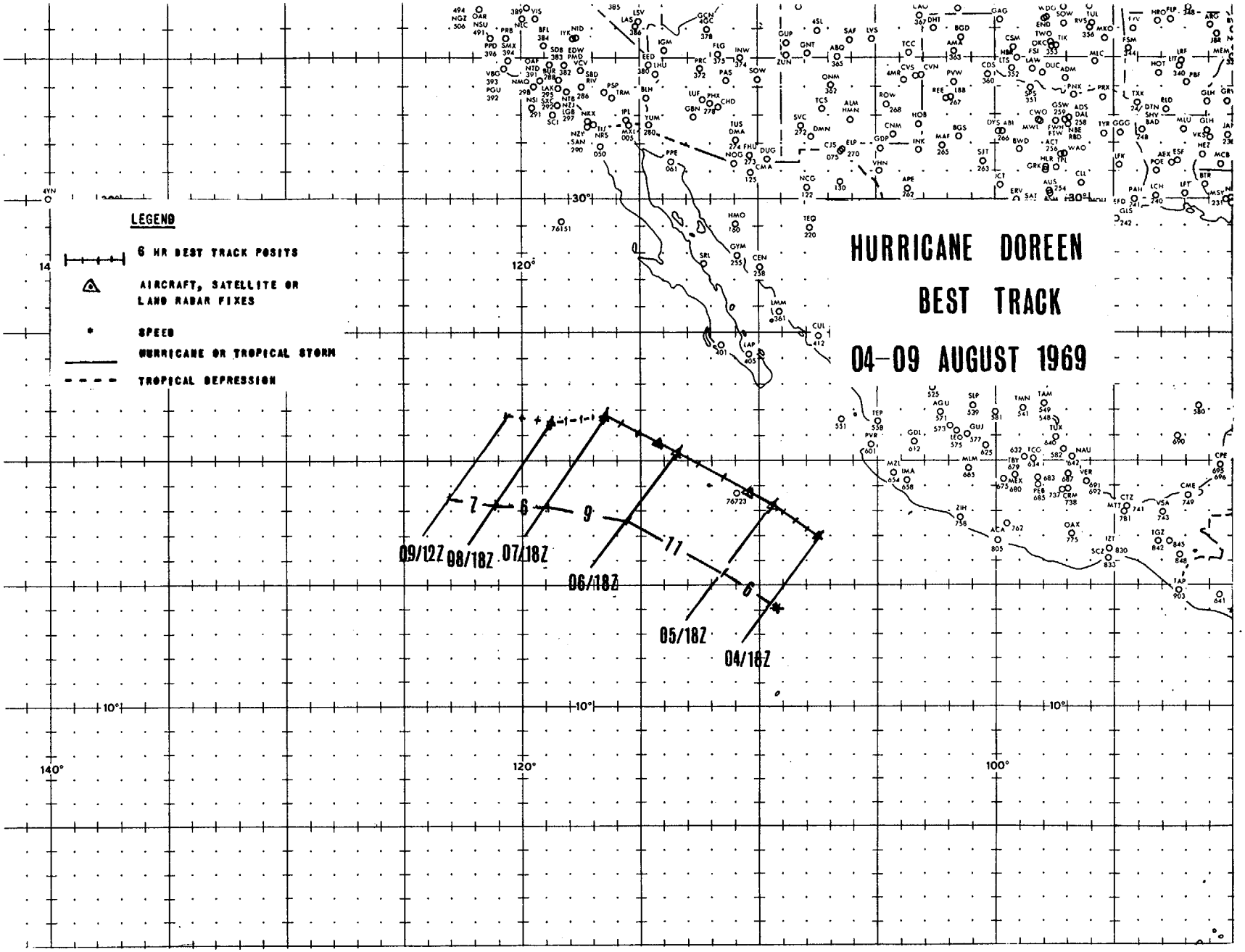
A. INITIAL IMPETUS - ITCZ

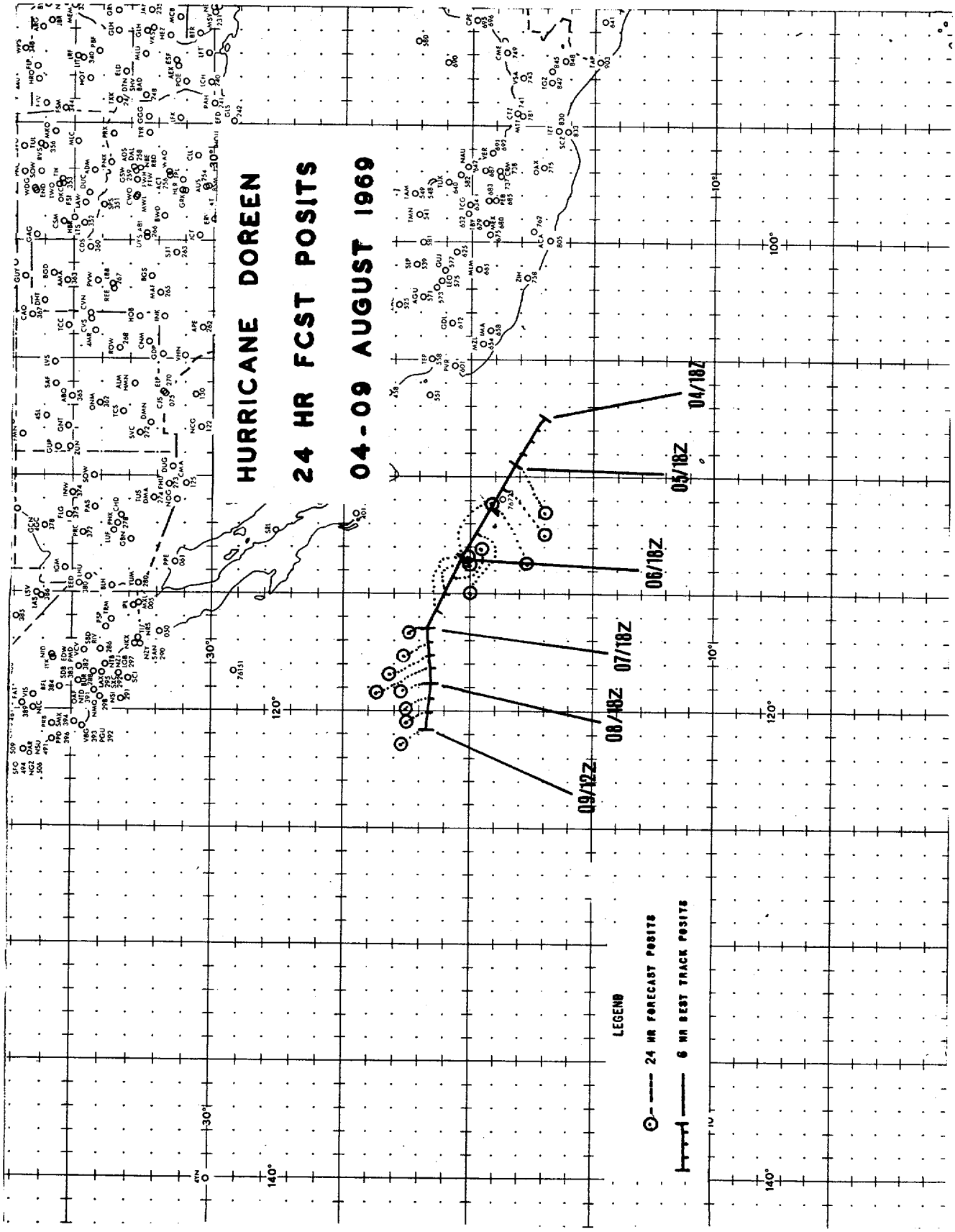
B. INITIAL SURFACE VORTEX
1. 041800Z
2. SURFACE PRESSURE LESS THAN 1008 MB

C. TIME STORM REACHED HURRICANE INTENSITY - 051800Z

III. FINAL DISPOSITION

A. DISSIPATED OVER WATER


LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT, SATELLITE OR LAND RADAR FIXES
SPEED
HURRICANE OR TROPICAL STORM
TROPICAL DEPRESSION
HURRICANE DOREEN
BEST TRACK
04-09 AUGUST 1969
09/12Z
08/18Z
07/18Z
06/18Z
05/18Z
04/18Z
7
6
9
11
6
30°
120°
10°
140°
100°
14


HURRICANE DOREEN
24 HR FCST POSITS
04-09 AUGUST 1969
04/18Z
05/18Z
06/18Z
07/18Z
08/18Z
09/12Z
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS

HURRICANE DOREEN
04-09 AUGUST 1969

DTG	LAT	LONG	24 HR ERROR	48 HR ERROR	72 HR ERROR
041800Z	17.0N	107.5W	-	-	-
050000Z	17.0N	108.5W	-	-	-
050600Z	17.0N	109.5W	-	-	-
051200Z	17.7N	110.7W	-	-	-
051800Z	18.2N	109.5W	240/135	-	-
060000Z	18.7N	110.0W	220/133	-	-
060600Z	18.8N	111.5W	240/144	-	-
061200Z	19.1N	111.9W	285/192	-	-
061800Z	20.3N	113.4W	115/150	215/235	-
070000Z	20.6N	114.1W	135/75	220/210	-
070600Z	21.1N	115.0W	132/96	222/238	-
071200Z	21.6N	115.8W	125/158	280/204	-
071800Z	21.8N	116.5W	340/36	115/230	-
080000Z	22.0N	117.0W	315/52	130/115	230/270
080600Z	22.1N	117.7W	323/74	118/117	-
081200Z	22.2N	118.4W	330/96	110/195	290/355
081800Z	21.5N	118.8W	350/75	335/192	-
090000Z	21.6N	119.7W	355/57	330/195	080/120
090600Z	21.6N	120.3W	355/60	335/226	-
091200Z	21.7N	120.8W	330/74	335/250	075/260

24 HOUR FORECAST ERROR = 100.4 MILES
48 HOUR FORECAST ERROR = 200.6 MILES
72 HOUR FORECAST ERROR = 251.3 MILES

HURRICANE GLENDA - 09/08/0000Z to 09/12/0600Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 18
2. NUMBER OF WARNINGS WITH HURRICANE INTENSITY 1
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1248 MILES

B. CHARACTERISTICS
1. MINIMUM OBSERVED SEA LEVEL PRESSURE - UNKNOWN
2. MINIMUM OBSERVED 700 MB HEIGHT - UNKNOWN
3. MAXIMUM SURFACE WIND - 65 KT
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 125 MILES

II. DEVELOPMENT

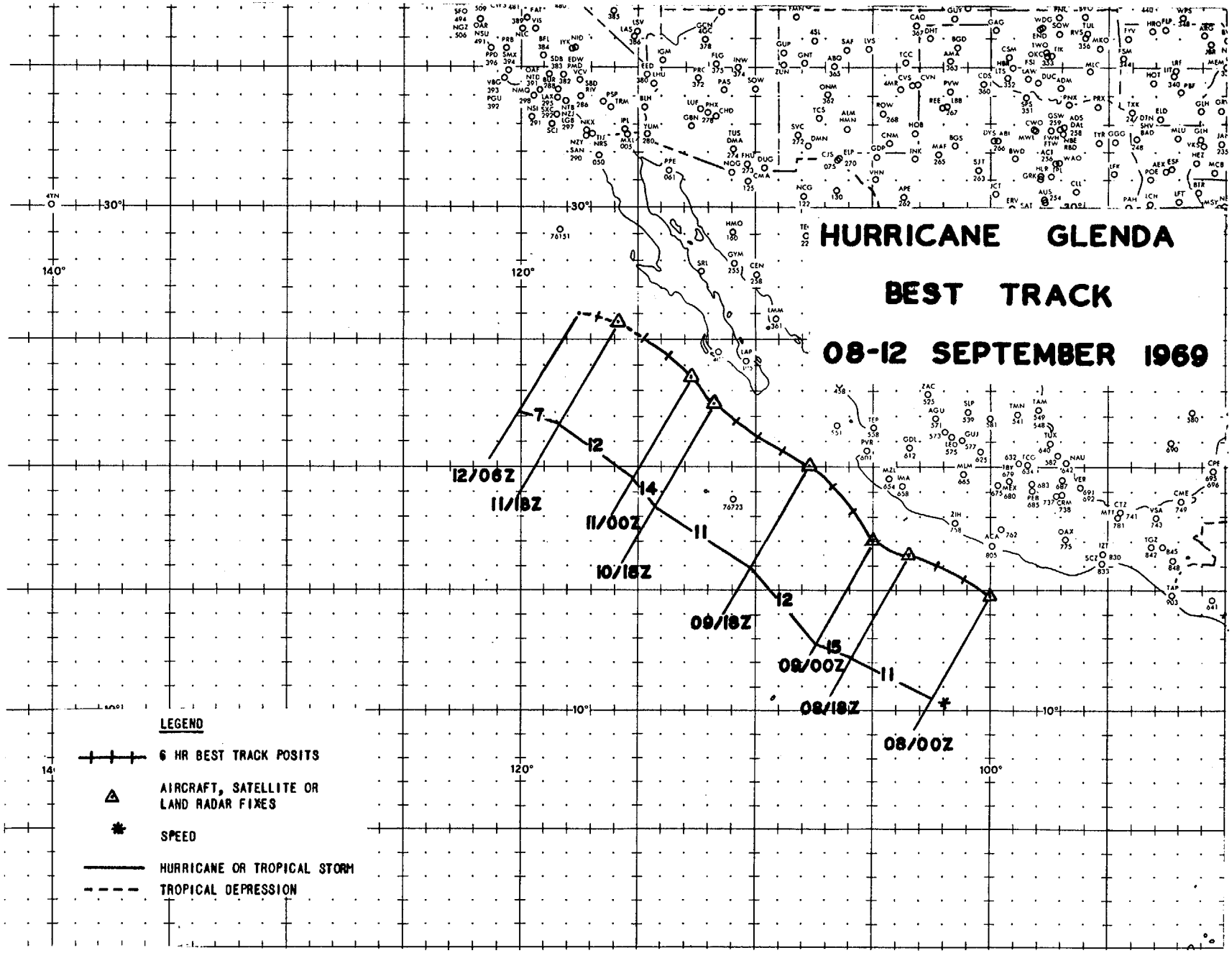
A. INITIAL IMPETUS - ITCZ

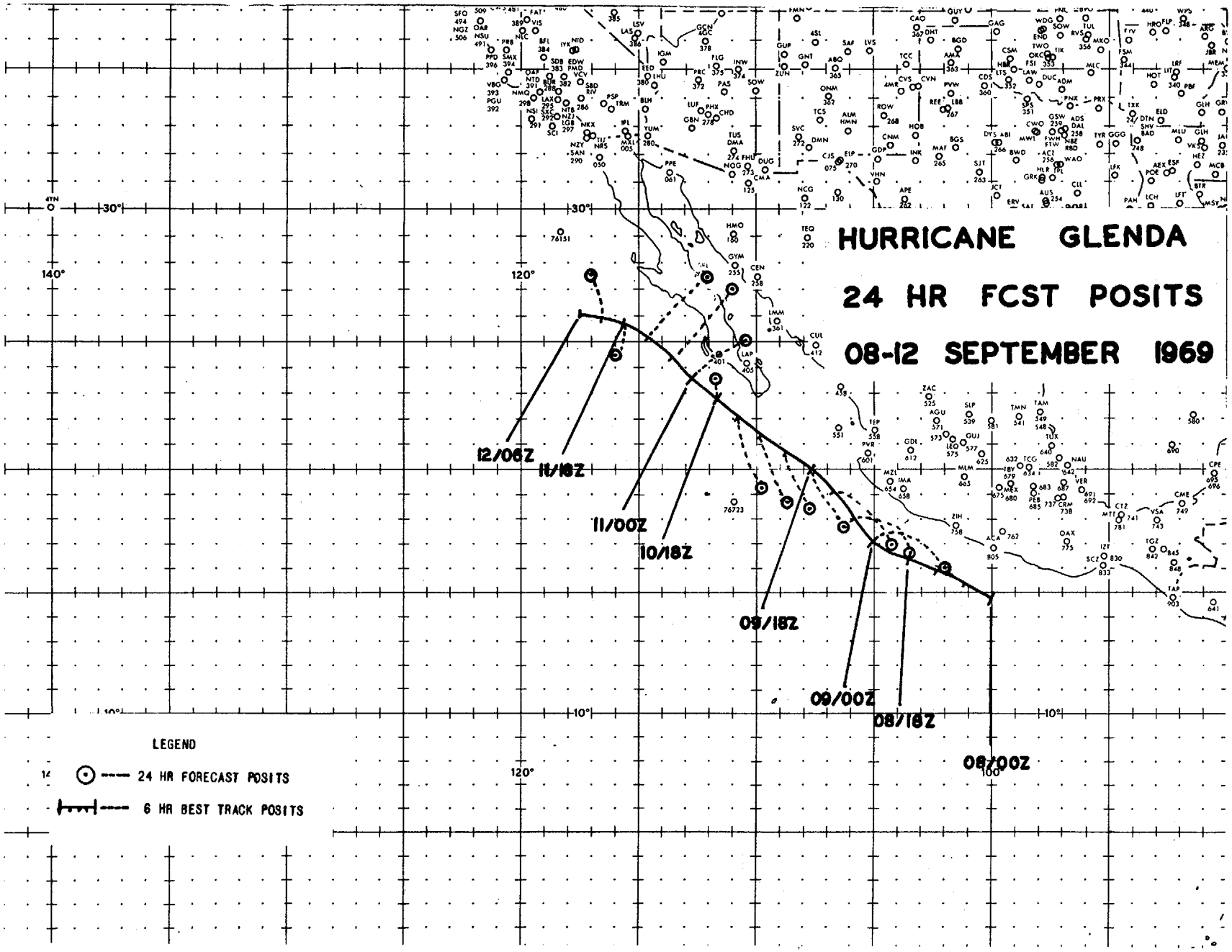
B. INITIAL SURFACE VORTEX

1. 080000Z
2. SURFACE PRESSURE LESS THAN 1008 MB

III. FINAL DISPOSITION

A. DISSIPATED OVER WATER


HURRICANE GLENDA
BEST TRACK
08-12 SEPTEMBER 1969
12/06Z
11/18Z
11/00Z
10/18Z
09/18Z
09/00Z
08/18Z
08/00Z
7
12
14
11
12
15
11
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT, SATELLITE OR LAND RADAR FIXES
SPEED
HURRICANE OR TROPICAL STORM
TROPICAL DEPRESSION


HURRICANE GLENDA
24 HR FCST POSITS
08-12 SEPTEMBER 1969
12/06Z
11/18Z
11/00Z
10/18Z
09/18Z
09/00Z
08/18Z
08/00Z
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS

AN-21

HURRICANE GLENDA
08-12 SEPTEMBER 1969

DTG	LAT	LONG	24 HR ERROR	48 HR ERROR	72 HR ERROR
080000Z	14.8N	100.0W	-	-	-
080600Z	15.4N	101.5W	-	-	-
081200Z	15.7N	102.1W	-	-	-
081800Z	16.4N	103.5W	-	-	-
090000Z	17.0N	105.0W	110/185	-	-
090600Z	17.3N	105.7W	110/137	-	-
091200Z	17.7N	106.5W	110/145	-	-
091800Z	20.1N	107.7W	150/165	-	-
100000Z	21.0N	108.4W	170/165	150/258	-
100600Z	22.4N	109.1W	175/225	140/350	-
101200Z	23.5N	109.4W	185/258	150/372	-
*101800Z	22.6N	111.8W	325/45	155/230	-
110000Z	23.5N	112.7W	055/160	150/258	130/504
110600Z	24.4N	113.7W	055/270	160/280	-
111200Z	25.5N	114.0W	050/190	165/360	135/516
111800Z	25.7N	115.7W	195/78	360/68	-
120000Z	25.3N	116.6W	350/130	055/190	140/335
120600Z	26.0N	117.5W	DISSIPATED		

24 HOUR FORECAST ERROR = 165.6 MILES
48 HOUR FORECAST ERROR = 262.9 MILES
72 HOUR FORECAST ERROR = 451.7 MILES

* RELOCATED

HURRICANE JENNIFER - 11/08/1800Z TO 11/12/0300Z

I. DATA

A. STATISTICS
1. NUMBER OF WARNINGS ISSUED - 15
2. NUMBER OF WARNINGS WITH HURRICANE INTENSITY - 8
3. DISTANCE TRAVELED DURING WARNING PERIOD - 754 NM

B. CHARACTERISTICS
1. MINIMUM OBSERVED SEA LEVEL PRESSURE - N/A
2. MINIMUM OBSERVED 700 MB HEIGHT - N/A
3. MAXIMUM SURFACE WIND - 70 KTS
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 65 NM

II. DEVELOPMENT

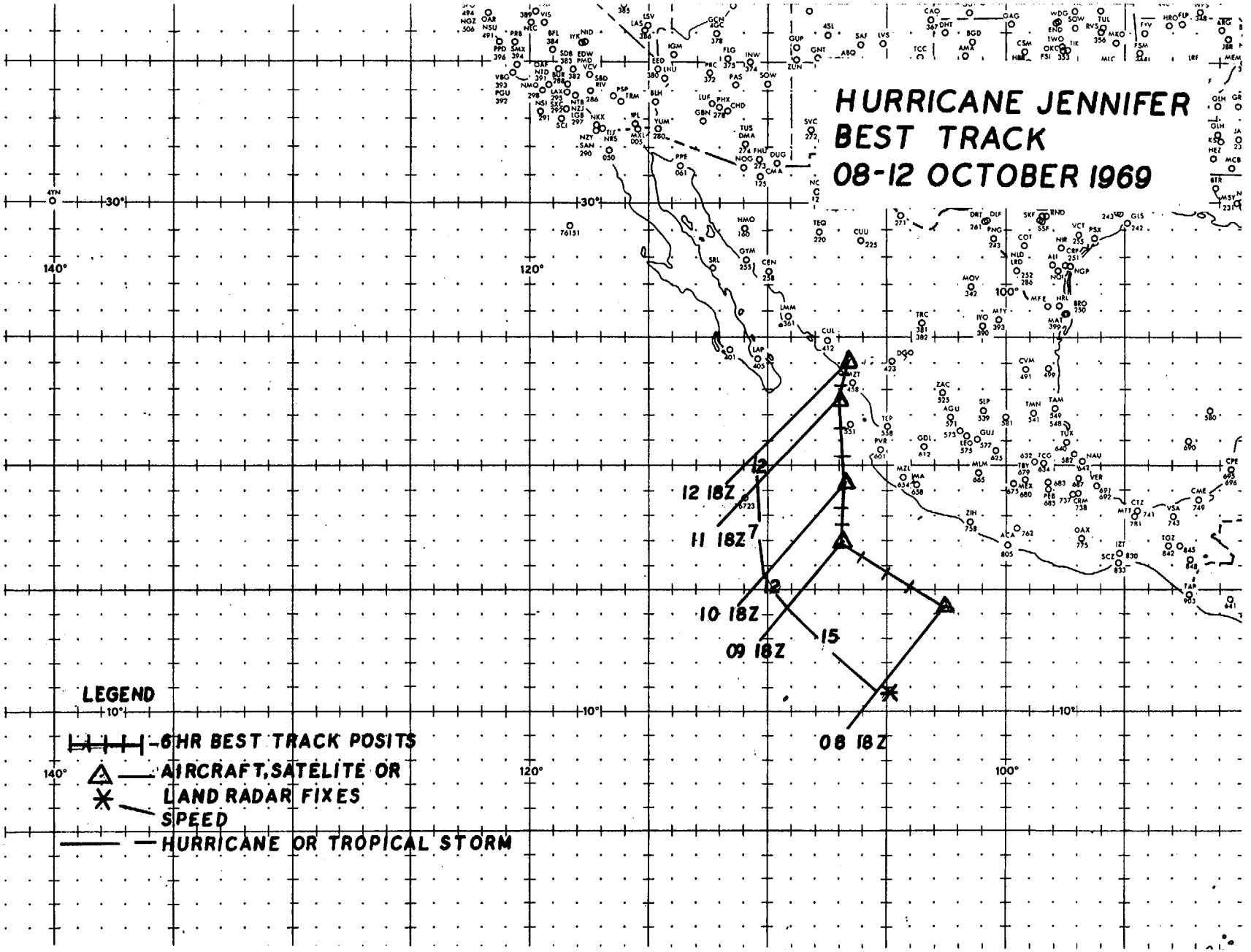
A. INITIAL IMPETUS - ITCZ

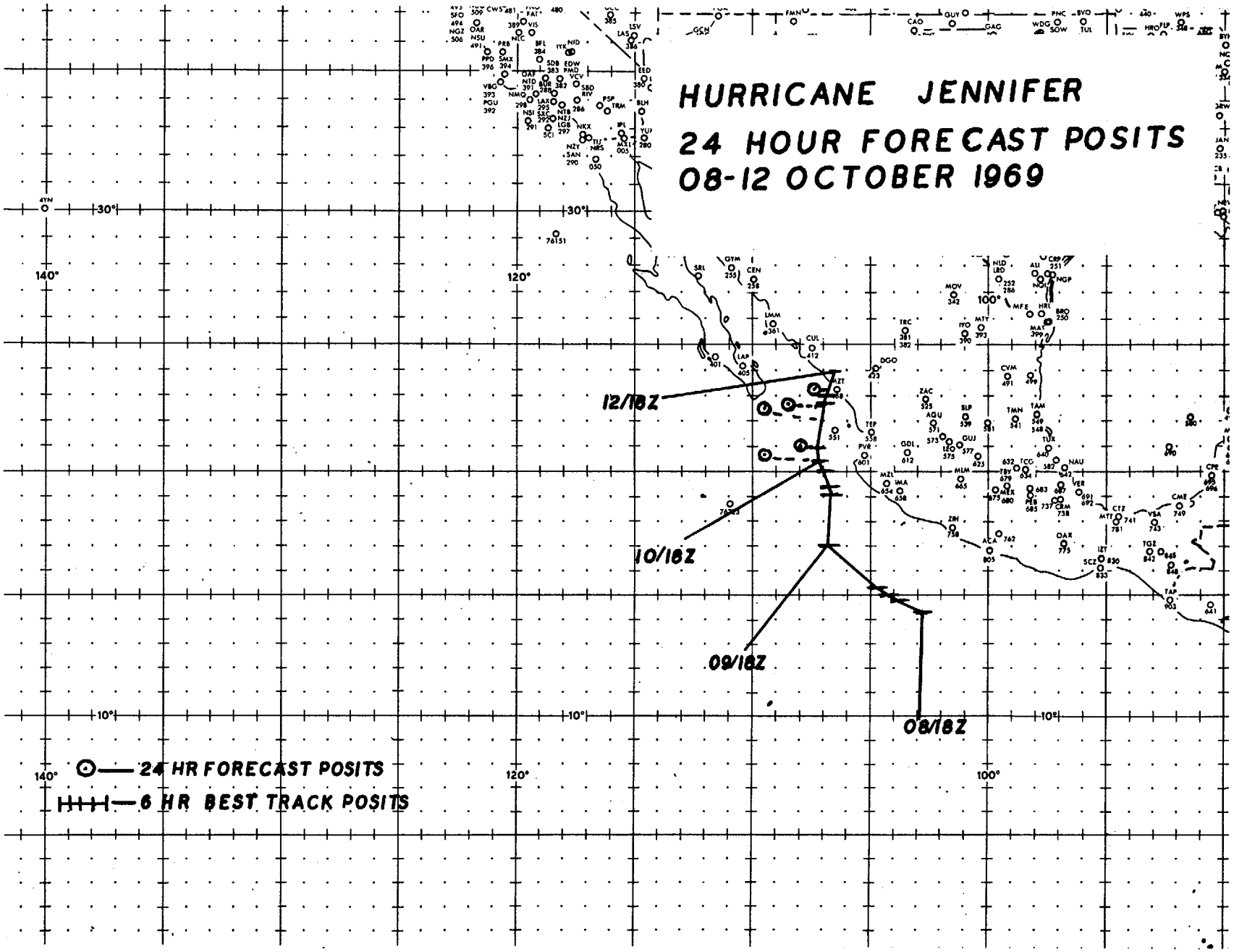
B. INITIAL SURFACE VORTEX
1. 08/1800Z
2. SURFACE PRESSURE LESS THAN 1008 MB

C. TIME STORM REACHED HURRICANE INTENSITY - 09/1800Z

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND.


HURRICANE JENNIFER
BEST TRACK
08-12 OCTOBER 1969
12 18Z
11 18Z
10 18Z
09 18Z
08 18Z
12
12
12
15
LEGEND
-6HR BEST TRACK POSITS
AIRCRAFT, SATELITE OR
LAND RADAR FIXES
SPEED
HURRICANE OR TROPICAL STORM


HURRICANE JENNIFER
24 HOUR FORECAST POSITS
08-12 OCTOBER 1969
12/18Z
10/18Z
09/18Z
08/18Z
⊙— 24 HR FORECAST POSITS
HHHH— 6 HR BEST TRACK POSITS
30°
140°
120°
100°
10°

HURRICANE JENNIFER
08-12 NOVEMBER 1969

DTG	LAT	LONG	24 HR ERROR	48 HR ERROR	72 HR ERROR
081800Z	14.0N	102.5W	-	-	-
090000Z	14.2N	102.7W	-	-	-
090600Z	14.8N	104.6W	-	-	-
091200Z	15.2N	106.2W	-	-	-
091800Z	17.0N	106.9W	170/132	-	-
100000Z	18.1N	107.3W	190/175	-	-
100600Z	19.2N	107.8W	200/246	-	-
101200Z	19.5N	107.8W	220/270	-	-
101800Z	19.3N	108.6W	320/115	220/252	-
110000Z	20.0N	108.8W	330/187	240/330	-
110600Z	20.3N	109.0W	360/213	240/393	-
111200Z	20.9N	109.1W	020/138	240/437	240/509
111800Z	22.7N	107.0W	-	-	-
120000Z	24.0N	106.5W	-	-	-

24 HOUR FORECAST ERROR = 185 MILES
48 HOUR FORECAST ERROR = 353 MILES
72 HOUR FORECAST ERROR = 509 MILES

APPENDIX A

ABBREVIATIONS AND DEFINITIONS

1. Words and phrases that appear frequently in this report are abbreviated as follows:

ANAL	Analysis
APT	Automatic Picture Transmission
ATS	Applications Technology Satellite
CINCPAC	Commander in Chief, Pacific
CINCPACAF	Commander in Chief, Pacific Air Force
CINCPACFLT	Commander in Chief, Pacific Fleet
CIRC	Circulation
CPA	Closest Point of Approach
DEG	Degree(s)
DTG	Date-Time Group
ESSA	Environmental Science Services Administration
FNWC	Fleet Numerical Weather Central, Monterey, California
FWC/JTWC	Fleet Weather Central/Joint Typhoon Warning Center, Guam
ITCZ or ITC	Intertropical Convergence Zone
JHWC	Joint Hurricane Warning Center, Hawaii
KT(S)	Knot(s)
MAX	Maximum
MB(S)	Millibar(s)
MIN	Minimum
MI or N.M.	Nautical Miles
MOD	Modification
NEDN	Naval Environmental Data Network
NESC	National Environmental Satellite Center, Suitland, Maryland
POSIT(S)	Position(s)
PROG	Prognosis
RECON	Reconnaissance
SLP	Sea Level Pressure
T.	Typhoon
T. D.	Tropical Depression
T. S.	Tropical Storm
VW1	Airborne Early Warning Squadron ONE
54WRS	54th Weather Reconnaissance Squadron

2. The following items define and clarify certain words and phrases that appear in the Eye Fix Summaries in Chapter V. Several definitions in this section have special meanings with regard to the machine prepared Eye Fix Summaries and may not necessarily have the same meaning as used elsewhere in the report.

a. FIX NO. - the chronological order of fixes for each individual tropical cyclone.

b. TIME - the date-time of the fix.

c. POSIT - the latitude and longitude of the fix.

d. UNIT - METHOD - ACCY:

(1) UNIT - the unit that made the fix if made by a reconnaissance squadron; 54-54WRS, VW-VW1.

(2) METHOD - the method used to make the fix; P - penetration, R - radar (these two refer to fixes by reconnaissance squadrons), LND RDR - land radar, SHP RDR - ship radar, SLTIS - satellite cloud picture location.

(3) ACCY - center determination and estimated navigational accuracy of the fix (in nautical miles).

e. FLT LVL - altitude of aircraft at time of fix in whole meters above mean sea level or given as a constant pressure surface; or, stage (STG) of development for a satellite location.

f. FLT LVL WND - maximum observed flight level wind speed in knots; or, diameter (DIA) in whole degrees of latitude for a satellite location.

g. OBS SFC WND - maximum observed surface wind speed in knots; or, number of bands (BNDS) for a satellite location.

h. OBS MIN SLP - minimum observed sea level pressure in whole millibars (reported on penetration fixes only).

i. MIN 700 MB HGT - minimum observed 700 mb level height in whole meters.

j. FLT LVL TT/TD - flight level temperature (TT) and dewpoint (TD) at fix location.

k. EYE FORM - description of cloud eye; CIRC - circular, ELIP - elliptical.

l. ORIENTATION - direction of orientation of an elliptical eye to an eight point compass.

m. EYE DIA - eye diameter or major/minor axes of an elliptical eye, in N. M.

n. THKNS WALL CLOUD - thickness of wall cloud in N. M. if observed. F. B. (feeder bands) or N. F. B. (no feeder bands) may be entered if wall cloud thickness not observed.

3. The following definitions are given to clarify usage in this report:

a. VORTICES:

(1) Cold vortex - a closed cyclonic circulation identified as having originated as a cold core system removed from the ITCZ or any easterly wave.

(2) Embedded vortex - a closed cyclonic circulation along an easterly wave and separated from the ITCZ.

(3) Junction vortex - a closed cyclonic circulation at the junction of an easterly wave and the ITCZ.

b. RECONNAISSANCE FLIGHTS:

(1) Synoptic track - a set reconnaissance pattern between specified coordinates scheduled to gather and report Meteorological data.

(2) Investigative flight - weather reconnaissance of an area containing a suspected circulation.

(3) Fix mission - aircraft reconnaissance scheduled to fix the center position of and gather peripheral data about a known tropical cyclone.

c. FIX - the determination of the position of a tropical cyclone at a precise time, generally by reconnaissance aircraft penetration of the center or by airborne, land, or ship radar. In the case of a reconnaissance aircraft penetration the actual fix may be based on any of the following: visual observation of the cloud pattern and sea surface, radar, surface pressure, surface or flight level winds, constant pressure height or temperature.

d. The term "tropical cyclone" has two definitions as used herein depending on usage:

(1) "Tropical cyclone" may be used to describe a suspect cyclonic circulation which appears to be capable of intensification.

(2) "Tropical cyclone" may be used in the general sense e.g., "Typhoon Agnes was the most intense tropical cyclone of 1968", or "tropical cyclones most frequently develop during August and September".

e. TROPICAL DEPRESSION (T.D.) - as used by JTWC this is a numbered tropical cyclone in which the maximum sustained surface wind speed is 33 knots or less and whose winds are expected to increase to 34 knots or more within 48 hours.

f. TROPICAL STORM (T.S.) - a named tropical cyclone in which the maximum sustained surface wind speed is greater than 33 knots but less than 64 knots.

g. TYPHOON/HURRICANE - a named tropical cyclone in which the maximum sustained surface wind speeds are 64 knots or greater. West of 180 degrees longitude these are called typhoons, east of

180 degrees they are called hurricanes. All references to typhoons apply equally to hurricanes.

h. Recurvature - that point at which a tropical cyclone ceases movement to the west of north and commences moving east of north.